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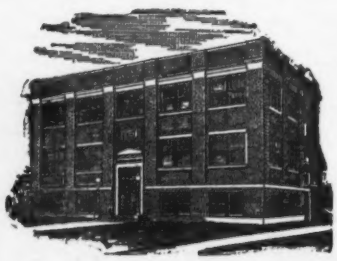

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JOINT, NERVE, AND OTHER INJURIES IN WAR SURGERY[1]

BY SIR ROBERT JONES, K.B.E., C.B., M.CH., F.R.C.S., LIVERPOOL, ENGLAND

I APPRECIATE more deeply than I can express the great honor you have done me by inviting me to address you as a delegate from Britain. The admiration I have for the surgery of America and for the countless personal friends who practise it would alone make this voyage memorable to me; but, in addition to this, I can never forget the debt under which we are placed for help given to us at a very critical period at home.

The loan of twenty-five keen and experienced young surgeons placed at my disposal for the duration of the war, equipped and paid for by the American Government, has placed an obligation upon us very difficult to repay, and which I can only express in terms of affectionate gratitude. How that band of twenty-five rapidly swelled to close upon a hundred is known to many of you; but we on the other side, who lived among them, inspired by their energy, their sense of responsibility, their loyalty and devotion to duty, can alone speak of the sweet memories they have left behind. They filled a gap which seriously threatened to sterilize our reconstructive efforts and they filled it with distinction and success.

When your nation entered upon the war, most of our more tragic problems were being overcome. Sepsis and gas gangrene had largely lost their terrors. Shock was being adequately dealt with; wounded men at advanced units were promptly and effectively handled; continuity of treatment from regimental aid post to the base was being secured, and standardization of principles and methods appreciated and practised. Team-work was in full swing, while the segregation of special cases under expert men had already made advance.

But in the early days of the war, when the wounded passed into our country in countless numbers, our hospitals soon became full to overflowing. The same conditions were experienced in France. There was nothing for it but to evacuate the less serious cases to make room for others, with the result that our towns and even villages began to feel the burden of the cripple. If the men were not discharged they were found segregated in command depots, and these depots from their nature were not equipped with the personnel which could effectively deal with them.

A visit through these large camps very easily proved to us that it was necessary to have certain hospitals governed by less stringent rules, where every accommodation should be provided for the type of case which required a sufficiently protracted stay to prevent deformity and to restore function. At Sir Alfred Keogh's request, an experiment was first made in Liverpool, where 250 beds were placed at our disposal. Later, in Liverpool this number grew to 1500, and fresh centers were started in Great Britain and Ireland until the number reached over 25,000.

[1] An address presented before the Clinical Congress of American College of Surgeons, New York City, October 20-24, 1919.

Difficult as it was to find beds, it was even more difficult to find surgeons to superintend them, for all medical men under 45 were commandeered for foreign service and it was the *young* men who were badly needed—men of sound surgical training, with minds sufficiently open and flexible to grasp and solve new problems.

Visits to general hospitals and command depots clearly proved that without segregation and continuity of treatment, we were in danger of scrapping thousands of cases who possessed the potentialities of recovery; and these were not merely the serious cases, but also those lesser injuries upon the recovery of which we depended in order to replenish our fighting forces.

Among the cases we met with in these tours of inspection were malunited and ununited fractures, especially femurs. Stiff and ankylosed joints; flail joints; the after-effects of injuries to peripheral nerves; and deformities due to the contraction of scars. Many of these conditions were recoverable, and most of them might have been prevented.

These cases, when admitted into our centers, had usually been to several hospitals. They were generally discontented and by no means willing to undergo any further manipulated or operative attack. They did not necessarily come from our small auxiliary hospitals, but often from those institutions where, in normal times, we would find the most skillful and eminent surgeons.

Our first effort consisted in endeavoring to improve the mental outlook of the men and in making every effort to humanize the hospital. Persuasion and explanation took the place of command and penalty, and our various centers with their annexes became hives of industrious and contented men. In a very short time they were prepared to submit to anything we wished.

The segregation into large centers of so widely different groups of cases involved great responsibility, more especially the nerve cases. Frequently I had been told by neurologists who operated in various hospitals that they were quite unable to follow their cases; there was no possibility of retaining them in the war hospitals, where convoys continually arrived, for much longer than it required to heal the wound. They were evacuated and found again in various small country hospitals, or even in command depots, under conditions anything but desirable. These cases consequently had to be admitted to our centers, and it was therefore necessary to secure the service of eminent neurologists to help in the treatment. As most of the nerve injuries were accompanied by other lesions they were very admirably placed for general supervision.

NERVE INJURIES

It may be of interest to mention briefly certain lessons we have learned in the treatment of these peripheral nerve injuries. The complications were such that we were often obliged to wait until they were overcome before any operation could be undertaken. Suppurating wounds, involving bones, muscles and tendons, and stiffness of joints, all delayed an attack upon the nerve. Muscles had to be freed and developed; and osteomyelitis drastically extirpated in order to render the muscles receptive to impulse. The sooner these complications were overcome or improved the better the chance for the nerve, not because delay in operating upon the nerve lessened the chance of regeneration, but because a chronic myositis very seriously impaired the power of the muscle to react when recovery of the nerve path was re-established.

Experience taught us that it was better to explore earlier and more frequently than we did at the beginning of the war.

It is found that if a nerve is simply contused or compressed, and has undergone wallerian degeneration, it will early show signs of recovery. In cases which do not spontaneously recover in a month or two, it is usually a mistake to await regeneration of the nerve, and an exploratory operation should be undertaken. Inspection of the exposed nerve at the time of operation and its faradic excitability should be regarded as a part of the diagnosis. It is essential in such cases that the surgeon should be experienced in nerve surgery, and be prepared to close the wound without interfering with the nerve, if it has an intact sheath and gives a faradic

response when tested with a weak current. It is probable that no interval between wound and operation is too long to preclude possible recovery after suture. The state of the muscles, tendons, and joints is the important factor.

It has been found in practice that end-to-end suture can be attained in the great majority of cases by flexing of joints, adduction of arm, and transposition of nerves. In the rare instances where the nerve could not be brought together we found this could be accomplished by a two-stage operation. Silk was tied around the bulbs and they were brought together as nearly as possible, extra length being secured by posturing the limb. The wound was then closed and gradual traction applied to the nerve through the limb for some weeks. At the second operation it was found that the ends could usually be brought together. It is needless to emphasize the importance of approaching the nerve through normal tissue above and below the lesion were it not that even yet surgeons may be found making the exploration through scar tissue. Nothing is to be gained from surrounding the suture line with vein or cargile membrane or fat introduced from without. If the nerve has to be protected from scar tissue, a living muscular flap is indicated, but, whenever possible, the scar tissue should be freely excised. The Medical Research Committee, whose report is not yet published, have carefully investigated a large number of cases operated upon. In the case of nerve grafting they have not met with one case of complete recovery, and with but very few partial recoveries. Most cases have ended in complete failure. Bridging by catgut, vein, alcoholized nerve and other foreign material has consistently disappointed. The turning down of flaps of nerve, and nerve crossing or anastomosis, i. e., implanting the distal end of the divided nerve into a healthy one, invariably fails. The conclusion come to is that end to end suture by a one stage, or if necessary, two stage operation, is the method to be adopted in every case.

In cases of irreparable damage to the musculospiral or posteri interosseous tendon transplantation when properly performed has proved an unqualified success. It must be associated with a good technique, and be followed by careful re-education. The operation I suggested in pre-war days with certain modifications I still recommend, but I advocate a more frequent use of the pronator radii teres. The flexor carpi radialis and the flexor carpi ulnaris can be transplanted into the paralyzed extensors of thumb and fingers, and the pronator radii teres may be affixed to the radial extensors. In transplanting tendons it is important to pay careful attention to the correct tension, and for this purpose the hand and fingers should be kept well dorsiflexed when the attachments are being made, and the transplanted tendon must run a straight course from its origin to its new insertion. Attention to these points will make the difference between success and failure. If the operation is a real success, the fingers and thumb can be easily fully extended. Tendon transplantation with the object of merely dorsiflexing the wrist should be discouraged, and tendon fixation with the object of permanently fixing the wrist in dorsiflexion should be reserved for those cases where transplantation has been a failure and where the extensor muscles and tendons have been destroyed.

Paralysis of the anterior crural is very rare, probably because the femoral vessels are usually destroyed by the missile. We have here a choice of hamstrings to attach to the patella. Strangely enough, I have only met with one case, and in this instance the recovery after transplantation was sufficiently good to permit of climbing stairs with increasing power.

Tilanus, of Holland, some twenty years ago, suggested an operation for flail feet in poliomyelitis which he termed tenodesis. He used paralyzed tendons as ligaments in order to sling the foot at right angles. Gallie and others have worked on similar lines. This operation, with modifications, we have found helpful in drop foot, due to sciatic injury where suture is impossible.

The peroneus longus is cut about three inches above the external malleolus, and the tendon is withdrawn through an incision

above the base of the fifth metatarsal. The loose tendon is then passed through the annular ligament and through a tunnel bored through the tibia. The tibialis anticus is also cut and passed through the same tunnel. The tibialis is passed from within outward, the peroneus from without inward. The foot is dorsiflexed to a shade beyond the right angle, and the transplanted tendons are drawn tight and attached to each other. The peroneus brevis is cut and attached to the fibula. The result of the operation is very satisfactory, much more so than in the case of children, where problems of growth have to be considered.

The prognosis as regards functional utility after nerve suture depends very largely upon which particular nerve has been injured. Thus, the musculospiral usually makes a good recovery, while the ulnar, as regards the intrinsic muscles of the hand, does badly. Another factor of importance in prognosis is the occupation of the patient. A man with an ulnar nerve lesion will usually recover both sensation and muscular control quite well enough for most trades, but he will not recover control of the finer movements of the hand, such as are needed for piano playing.

After the musculospiral, in order of good recoveries, we must place the sciatic. The results of suture here are surprisingly good. A large number of our cases were examined two or three years after suture. Some of these men could jump, climb ladders and run, and many have returned to their pre-war employment.

The brachial plexus often makes a good recovery, especially the upper part. Plexus lesions should be watched for a long time, 6 to 9 months, or more, and not operated on for exploratory purposes as are the nerves themselves, because they frequently make excellent progress, and a generalized paresis may later be limited to one cord, or nerve.

Median injuries do fairly well, the thumb intrinsics even functioning in some cases, while it is usual for the wrist flexors and considerable sensation to recover. Sensation, however, is usually lost, or very slowly or rarely recovered from, over the terminal phalanx of the index fingers.

The ulnar recoveries are good as regards wrist and finger flexors, and even its sensory disturbance clears up well. As has been stated, good recovery of the interossei is very rare. They may and do recover their faradic excitability more often than voluntary power.

Combined lesions of the median and ulnar, particularly if complicated by ligation of the artery, do very badly. There is usually the stiff, rigid, board-like hand with joint changes, still further to hinder the chance of good function. This is indeed the important obstacle.

The after-treatment of cases of peripheral nerve injury has not undergone much change. The relaxation of muscles is essential, and it is also necessary that the relaxed position of the nerve should not be too early dispensed with, otherwise the recently regenerated axis cylinders will be ruptured. Interrupted galvanic stimulation, massage, heat and re-education are indispensable desiderata.

A series of very interesting trick movements have to be carefully watched for, when we test the amount of recovery following suture, or when we are making a diagnosis. Unless the surgeon is familiar with their occurrence, he is very liable to be misled.

In complete paralysis of certain muscles and muscle groups, the unaffected muscles acting in combination can replace the movements lost by paralysis in a very remarkable manner. For instance:

1. The opponens pollicis can be perfectly imitated by the ulnar adductors of the thumb in combination with the extensor ossis.

2. The extensor ossis may act as a good wrist flexor in cases of complete paralysis of all median and ulnar muscles.

3. The fingers may be closed in complete median and ulnar paralysis by extending the wrist when the inelastic paralyzed flexor tendons acting as ligaments permit the fingers to flex mechanically.

4. The elbow may be flexed by the pronator radii teres in combined lesions of musculocutaneous and musculospiral nerves.

5. Flexion of the fingers may extend the wrist in lesions of the musculospiral, simulating the movement of the wrist extensors.

6. In paralysis of postinterosseous exten-

sion of the thumb may be simulated by the opponens pollicis and abductor brevis, the contraction of which muscles lengthens the distance between the origins and insertions of the extensors of the thumb.

Although electrical stimulation will generally teach us to discriminate between the true and spurious movements, the observer must be on the alert, or he will be quite easily deceived.

BONE INJURIES

Sir Anthony Bowlby, to whose vision and organization we owe so much for surgical efficiency at the front, has already addressed us on "Fractures of the Femur" as he met with them in France. In the early days of the war, these injuries supplied our centers with a large proportion of deformities. In 1917, I described gunshot injuries of the femur as "the tragedy of the war," not only by reason of the fatality by which they were attended but also because of the deformity and shortening so often associated with them. This was due to the absence of effective team-work at home and abroad; a want of standardization of principles and splints, and of continuity of treatment from front to base and of the segregation of these injuries in special hospitals under expert men. I have it on the authority of Gray, who collected statistics over one of the Army areas in 1916, that the mortality from these fractures amounted to almost 80 per cent, a large proportion of deaths occurring in their way to, or at, the casualty clearing stations. In the year 1918, Sir Anthony Bowlby tells us that the mortality in field ambulances and in casualty clearing stations was reduced to less than 20 per cent.

To what are we to ascribe this dramatic change? First and foremost to the recognition, too long delayed, of the value of the Thomas splint, and to its distribution to the regimental aid posts. We cannot give too much credit to Sir Henry Gray for the work he did in this connection. In pre-war days a certain kind of homage was paid to the Thomas splint, but that was all. Its use was strictly limited, and in spite of its simplicity very few surgeons knew how to apply it, and in many of our teaching hospitals it was only known by name. In Liverpool we have long taught that fracture of the femur, simple or compound, treated by a Thomas split should, at the worst, not yield more than half an inch of shortening, and that if a surgeon desired it he could easily produce an appreciable lengthening. It has taken a great war to drive this truth deep home. The caliper splint which has been in use for over forty years was scarcely known. The standardization of the Thomas splint, the education of men in its use, its application on the field of battle, secured for the fracture immobilization and simplified transport, it minimized shock, and it prevented the perforation of vessels by securing the alignment of the broken ends. Its use had to be understood from the field to the base hospital, for continuity of treatment was imperative. At the base hospital it might be necessary in more leisurely fashion to apply modification in response to special requirements. A subjugation of sepsis and gas gangrene also played an important part in these improved statistics, with all those accessories for the prevention and lessening of shock, such as the heated ambulance, and the hot chambers. In addition to this, the mobile expert teams which were rushed from place to place allowed of more skilled and frequent operative treatment. Then came the equipping of special femur hospitals, where some of the best and most inspiring war work was done. In this connection I feel I must refer to the work of Major Sinclair, who displayed remarkable ingenuity, and whose cases arrived in England with barely any shortening and in excellent alignment. To him and to Colonel Pearson and Colonel Watkin Williams we are much indebted for excellent pioneer work. Pearson, who later took charge of one of our large femur hospitals, using the modified Thomas splint to permit of knee flexion, obtained traction by the introduction of ice-tongs calipers which gripped but did not penetrate the femur, and used suspension of the Thomas ring and elevation of the femur. In addition he designed a special bed which rendered dressing easy and painless.

In 300 cases of compound fracture treated

in England in one of the special military surgical centers where this method of extension was employed, the average shortening was half an inch. There can be no doubt that the use of safety ice-tongs caliper splints in the hands of experienced surgeons has been of very great service. The guard should always be affixed to it to prevent it from entering the bone. This is especially important if evacuation takes place during treatment. Many cases arrived in England where the knee-joint and ankle-joint had been infected by calipers which were introduced into cancellous tissue and worked their way downward. It must be remembered, however, that fracture of the femur can be effectively treated by the Thomas splint with ordinary extensions. The pressure of the ring can be modified by tying the end of the splint to the end of the bed which is elevated. Of 97 cases which were at the Liverpool Special Military Surgical Center at one time the average shortening was five-eighths of an inch, and the skilled nursing secured for the patient freedom from pressure sores and a comfortable convalescence. The extension calipers combined with a free knee-joint undoubtedly minimize a frequently obstinate stiffness, but they should never be used for transport purposes. The Thomas splint with plaster or glue extension is the ideal transport splint, and fractures of the femur such as we meet with in civil life can be most adequately dealt with by this apparatus in its simplest form. The stiffness of the knee which follows retention is of a very transient kind and is usually quite overcome after two weeks' massage and exercise. As a transport splint in civil life, it is ideal. On several occasions in bygone days when I assisted H. O. Thomas, I remember workmen being brought to him with fractured thighs. In a few minutes, without an anæsthetic, a splint was applied and the patient sent home often a considerable distance in a four-wheeled car.

The lessons that we civilian surgeons should learn from all this are clear. If such results are obtained by simple means in such compound fractures as have occurred in war, why should we have recourse to more complicated methods? Why should the student be taught that fractures of the femur can only be adequately dealt with by plates and screws or other internal splinting? Why should we spend so much ingenuity and time in devising operative novelties, when it is so much easier and useful to learn the simple way? In the hands of the expert and cleanly surgeon catastrophies may generally be avoided, but what of the rest? In every village and hamlet the humblest of us may be called to treat a broken thigh, and the humblest of us should know before he leaves his studies how this can be done with safety and success.

Many years ago, I pointed out that the textbook deceived us as to the time it takes for bone to consolidate sufficiently to bear body-weight. This delay in solidification is still more pronounced in war wounds. After several months of apparent union, angulation may occur unless the bone is protected. The use of the caliper splint is the best protection. This splint is a Thomas splint running into the heel of the boot, and it should be used in the later stages of treatment of all fractured femurs. The removal of the splint should be gradual, and the experiment should be made under careful observation.

Time will only allow me to touch upon a few of the many interesting surgical problems that we have worked among. We have found loss of substance the most common cause of non-union. This is more especially the case in the humerus and the femur. When there is another bone to maintain the length, non-union is less common. Esquillectomy, though at times inevitable, accounts for many of these gaps which do not fill up. It is quite impossible at the time of injury to say that a loose piece of bone has no blood supply. In the later stages of treatment we have been often impressed by the osteogenetic power of apparently loose pieces of bone, which have lived in suppurative areas. This has led us to advise the maintenance of the length of limb rather than to approximate the bone ends, more especially in the case of the femur. Gaps which on X-ray examination only exhibit a faint shadow here and there may ultimately be filled up with bone. Ununited fractures of the femur with loss of bone should be kept in caliper splints and allowed to wal-

with rubber tubes above and below the fracture. This, apart from maintaining the patient's health, increases local congestion and osteogenesis. Many ununited fractures of the humerus have been caused by prolonged and too powerful extension, and sometimes by the injudicious use of the Thomas arm splint. The Thomas arm splint is essentially a transport splint, and its prolonged use may give rise not only to non-union but also to ankylosed elbow, wrist and fingers. Compound fractures of the humerus is best treated with the arm abducted. Ununited fracture of the humerus is most surely united by the step cut operation, and the steps should be long. Shortening of the arm is of minor importance. Bone grafting proved of no appreciable value in filling gaps in the shaft of the femur or the humerus. Real adequate development rarely if ever was secured even if the graft lived. Several grafts which have been used to make up the deficiency in flail joints have fractured, and in the few that have survived for over a year there is but little promise of adequate stability. The best results from bone grafting are in association with the radius and ulna and the tibia so long as the fibula is intact, and I think that the method described by Hey Groves is best whereby the ends of the bone are freshened, their medullary cavity drilled, and a piece of tibia like a cricket ball is removed and the two sharpened ends are passed into the medulla. This technique is suited to non-union in association with a gap. If bone grafting is decided upon it should be done in two stages, the first being the removal of scar tissue. This allows of better blood supply to the graft and lessens the liability of sepsis. In malunited fractures we never operate in the presence of a sinus nor for some months after it has closed. We hasten the healing by a free exsection of sinus, scar and bone. If the alignment of the bone is good and the shortening does not exceed 1.5 inches we do not operate. If the alignment is good but there is marked rotation of the limb, we perform an osteotomy some distance from the fracture. In malunion we rarely evacuate the ends of the bone through the wound, but prefer to follow the attached surfaces with a chisel and trust to extension without internal splinting. Rough manipulation stirs up all hostile factors. We should be merely gently efficient. Although we know fractures will unite in the presence of sepsis, the sooner we eradicate sepsis, the firmer and better will union become. In recent and in ancient fractures all joints should be kept mobile, and the muscles should be regularly stimulated by electrotherapy.

RESTORATION OF FUNCTION IN JOINTS

The restoration of function in joints is too vast a subject to dwell upon. Suffice it to say that forcible movements are rarely indicated. Certain symptoms following manipulation and passive movements indicating injurious strain may be formulated.

If pain occurs after manipulation and is of short duration, movements may be continued.

If pain persists for lengthy periods after manipulation *rest* is indicated.

If the increased range of movement is maintained after manipulation further movements can be safely prescribed.

If in spite of movements, even in the absence of great pain, the range is continually diminishing, rest is indicated.

The duration of pain when tissues are relaxed, rather than its intensity, should be our clinical guide.

In overcoming adhesions and in subsequent manipulations, the joint should be put through its various movements only once. The oft-repeated pump-handle movements applied at each sitting are never useful and often start inflammatory symptoms. Voluntary movements can safely be allowed and should be encouraged. They are not followed by obstructive reaction.

The treatment of intractable stiffness and ankylosis will not be dealt with in this address.

One of the common products of the results of war injuries is the flail joint. In other words, a pseudo-arthrosis which is of very imperfect function because the bones forming it do not come in contact and, in consequence, the lever is imperfect because it has no fulcrum. The greater number of these disabilities are the direct results of excisions deliberately performed at casualty clearing sta-

tions or base hospitals. They were performed in order to save the limb from amputation, or the patient from death by minimizing local sepsis and preventing general sepsis. Joints are difficult to drain, and the excision simplified the immediate problem. The only competent judges of the necessity of these measures were the surgeons at the front, upon whom rested so many grave responsibilities. It is our duty to recognize this, and to try to lay down suggestions for the immediate and later treatment of these loose joints in order to minimize the loss of function.

It is well, however, to realize that upon the type of resection, as judged from cases which have arrived at our centers largely depends good or bad function. Cases of so-called limited resection have resulted in better function than where the excision has been extensive. Furthermore, cases where the sepsis has been overcome and the bones allowed to remain in position have resulted sometimes in very good and firm ankylosis with excellent function if the position of election has been maintained. There is no reason why any joint should be allowed to heal at functional disadvantage. This, however, is even yet not sufficiently appreciated. One draws attention to this, not as a matter of adverse criticism, but in case one may be tempted sometimes to excise too much bone, or to forget that the functional defects following extensive excision may be minimized by correct after-treatment.

The flail joint may follow (a) as a direct result of excision; (b) the removal by the surgeon of large comminuted pieces of bone; (c) the direct loss of bone from missile; (d) the extrusion of necrosed bone during sepsis.

In order to preserve function (a) the extent of excision should be strictly limited subject only to conditions of safety; (b) the extension applied should be very moderate and of short duration; (c) in the after-treatment ankylosis should be aimed at rather than mobility.

a. The limitation of extent of excision is very important. Muscular attachments which have important influence in maintaining good function should be spared where possible. The tuberosities of the humerus; the nerve supply of the deltoid; the condylar attachments of the muscles governing the elbow; the triceps expansion; the biceps insertion; the coronoid and, if possible, the whole or a portion of the olecranon should be preserved. Again, one should endeavor to retain as much width of the lower end of the humerus as is possible, in order to allow the surgeon to restore leverage later.

If it is impossible to leave the important muscular attachments *in situ*, it may be possible to chisel off the portion of bones to which the muscles are inserted, such as the olecranon, tubercle of radius, coronoid process and the tuberosities of the humerus. They may all be useful later for reconstructive purposes.

b. We should strictly limit extension both in extent and time. I have seen several cases where this was not done and where after excision of elbow, a Thomas arm splint has been applied for three months and more with separation of the joint surfaces for many inches. The extension should be strictly limited to the urgent needs of drainage. Strong extension of a limb where the joint has been excised obstructs free drainage. The extension, if necessary at all, should be of the lightest kind, and maintained for the shortest period possible. An abducted shoulder and a flexed elbow admit of excellent drainage. In the case of the shoulder and of the elbow, the dependent position of the arm and forearm permits of purulent tracking down the muscular planes.

c. Again the rule should be *to aim for ankylosis* in the best functional position. We need not here enter into the arguments for and against mobility. The fact that we aim for ankylosis does not mean we will attain it. We very rarely can, but the effort leaves us the best possible result for future reconstruction. The rule, therefore, should be that so soon as the surgeon can do so, he should place the bones as near together as he can, and in the best position for future function whether a pseudo-arthrosis or an ankylosis occurs.

TREATMENT OF THE FLAIL JOINT

The flail joint as we meet it is practically useless from the point of view of function,

and it demands mechanical or operative treatment or a combination of both.

Treatment may consist of (a) removal of necrotic bone and scar tissue; (b) correct posture; (c) operative attempts at improved pseudo-arthrosis; (d) production of ankylosis; and (e) retention in mechanical apparatus.

a. A fair proportion of flail joints, especially the shoulder is complicated by infected bone and is discharging. Where it is possible these cases should be treated like osteomyelitis elsewhere, i. e., by excision of sinuses, scars, and infected bone. Whether operated upon or not, the bone surfaces should be approximated and retained in the functional position. A surprising proportion of cases take in their slack and ankylose, or result in a much firmer pseudo-arthrosis.

The shoulder and elbow are the joints most responsive to this treatment.

b. Where all wounds are healed, the shoulder should be placed in the functional position either by means of an abduction splint or an angular elbow-splint, or in plaster. The latter method lends itself very well to these two joints and gives the much needed stability. The bones should be insinuated into juxtaposition to each other without crumpling the soft tissue between them. The fixation should be maintained without an interval for at least three months.

If the muscles governing the joint retain power, the after-treatment must be carefully conducted. In the shoulder the upper portion of the plaster support should be removed so that the arm rests on the gutter-shaped, under part of the cast. Liberty should be allowed the patient to exercise his deltoid, and when he can lift it slightly from the splint, the arm can be brought a little nearer to the side and the angle of the abduction splint, lessened, when a larger range of movement may be allowed the scapula and humerus. From time to time the arm is still further lowered until it can be safely dropped to the side. If the pseudo-arthrosis is bony or short fibrous, the shoulder blade becomes the joint. If there is free mobility the deltoid may be trained to lift the arm. This it does by raising the lower fragment and drawing it against the axilla with quite a useful functioning joint. The elbow-joint, when the arm is removed from the sling, should be more acutely flexed and the forearm slung by the wrist in order to strengthen the biceps and brachialis anticus. As these muscles gain in power, the forearm can be gradually lowered until it reaches a right angle. For a considerable time it should be kept from further extending in order to retain and increase the power gained by the flexor muscles. Such shoulders and elbows, however, are always weak, and in the elbow a considerable lateral instability results. A hinged splint gripping the elbow with a shoulder cap will be of advantage in the case of the unstable elbow.

c. Attempts may be made at improving the stability and retaining the mobility of weak pseudo-arthrosis by operation. This should only be attempted where the muscles governing the joints may be reasonably expected to recover strength. The operation consists in removal of intervening scar tissue and bringing the bones into closer contact. They may be kept together by means of kangaroo tendon or other absorbable material.

d. Ankylosis of the flail joint, often a difficult matter, will be discussed in relation to the joints involved.

In the case of the *hip*, if the femur has merely been deprived of the head and neck, all that is needed is to correct any deformity which obstructs walking, such as abduction. This can be done by division of the adductors. If the limb cannot bear weight a jointed caliper, that is a caliper allowing flexion at the knee, should be applied. This supplies an artificial lever, and the muscles governing flexion are enabled to resume their function. With such a splint the patient can walk long distances with ease and strength. When the trochanter and part of the shaft are also lost, again this splint proves very useful. Bone grafting, as usually understood, is of very limited application in the upper part of the shaft of the femur. Ankylosis in the case of limited excision of the hip is of no advantage, and certainly does not justify the severe operation which it would necessarily entail. If the trochanter and part of the shaft are removed, the most likely method of obtaining

an ankylosis is to take a long strip of femur half its thickness, and slide it into a prepared acetabulum. The slide should rest for two or three inches in the groove of the femur. Such a graft has a much better chance of life than when introduced from another part of the body. A thin graft removed from elsewhere never develops strength in the adult and will refracture. Mechanical measures, however, should be adopted in place of operation whenever possible.

Ankylosis of the joint is the only practical treatment for the flail *knee*, and if the bones are in good position, nothing is needed excepting to saw the ends and fix them with screw or nail. If there is a wide separation, however, and the ends have been associated with sinuses, union is not easily secured. In such a case it will be necessary, after sawing the ends of the bone, to bring a bulky, sliding graft from tibia or femur and wedge it in at right angles to the line of the joint. This is a method I have often employed in secondary excisions in pre-war days where union after excision has not been firm.

If there is shortening to the extent of many inches, the patient may prefer an artificial limb, and he may supply arguments worthy the surgeon's consideration.

If an operation is refused, the caliper splint and a high boot will afford the best help.

A flail *ankle* is so rare that I cannot recall an instance as the result of a war wound. Should it be met with, the treatment will lie between an ankylosis or an amputation.

I have already described the postural treatment we should adopt in the case of a flail *shoulder-joint*, and I have stated that a successful pseudo-arthrosis is very difficult to secure. In a limited number of cases where the head of the bone only has been removed, and where the muscles attached to the tuberosities and the deltoid are functioning, abduction and carefully conducted muscle reeducation may result in a joint preferred by some people to an ankylosis. The very flail joint can only be approached with confidence if an ankylosis be aimed at. I have seen certain cases where bone grafts have been introduced to lengthen the shaft, with results which have at first appeared promising. I have also seen these cases with their grafts refractured and never to unite again, and others which have been absorbed leaving the patient in a worse plight than before. The result of my experience is that I would prefer adopting a more certain route, such as the production of ankylosis by end-to-end apposition.

Many operations for fixing the shoulder have failed because the surgeon has been content to bare the glenoid and freshen the humerus. This is usually quite insufficient. If the deltoid has been hopelessly deprived of function, an excellent exposure can be obtained by turning back a flap of skin and exposing the upper part of the deltoid. This muscle can then be cut across or reflected upward as a flap. The joint should be fully exposed, and the glenoid gouged as deeply as possible. The base of the coracoid and the acromion should be chiseled, and the bony flaps left attached. The upper part of the humerus is then exposed and sawed through, and a groove made into the upper part of the shaft for the reception of the acromion. The humerus is pushed into the glenoid and the acromion sawn partially through and pressed into the groove prepared for it. The glenoid, humerus, and acromion should be fixed in contact by kangaroo tendon and the arm placed in the functional position. Major Naughton Dunn has pointed out to me that if there be much shortening of the humerus the functional position will vary from that which I advocated at the beginning of the war. If there is no loss of bone the position of selection is just in front of the coronal plane of the body, while if there is much loss of bone it will be necessary to fix it in a plane posterior to this. Otherwise, in flexion of the elbow the hand will pass beyond the mouth. It is advisable before fixing the shoulder to test the position by flexing the elbow and observing the relation of the hand to the mouth.

Before an arm is ankylosed, care should be taken to ascertain whether the scapula is mobile, also whether it retains its normal position in regard to the humerus. This is extremely important. The success of the operation depends on sound ankylosis *and a*

mobile scapula. If the scapula is fixed and the arm abducted the result of the operation is a tragedy, for the patient will have a fixed abducted shoulder with an arm he cannot lower. I have seen several such results.

After operation great care should be taken to exercise and re-educate the scapular muscles. The range of scapular movement in the young soldier increases for many months.

Two methods of treatment for flail *elbow* are available here: (a) the non-operative, (b) the operative.

The non-operative method consists of the approximation of the bone ends, counteracting the effect of gravity, and in muscle re-education and development. It also often involves the wearing of apparatus.

The operative treatment has one of two ends: (a) the formation of a bony ankylosis, (b) the provision of a mobile arm with stability.

How can we fix upon the type which should be operated upon and that where it is best not to operate.

The *non-operative* treatment is only likely to be successful where the bone ends are broad.

If the bone ends are pointed and distant, non-operative treatment cannot be successful even with good muscular control. Many surgeons have described how difficult it is to obtain union in flail elbows. Failure is probably due to a technique which trusts too much to limited surfaces of attachment.

There is so little vitality in the ends of the bones that a mere freshening with apposition and fixation will often fail to accomplish union. When nails are driven in the result is no better, and further interference with blood supply is the result. Operation must be designed whereby a larger apposition of raw surface is secured. This can be effected by splitting and reflecting the ends of the bones, and in this way widening them.

Time will not allow me to describe any of the many operations which we have adopted. From the nature of the bone ends no one routine operation can be prescribed. The principle in all is the same: freshen the bone ends, splint them without detaching the fragments, enlarge the area of bone apposition, and firmly immobilize.

Pseudo-arthrosis of the elbow. We need not now discuss pseudo-arthrosis of the elbow when this operation is performed for mobilizing an *ankylosis*. It is a different proposition when we wish to stabilize a flail joint and yet permit of voluntary movement. A necessary condition to the success of this operation is a sound muscular control. If this is not present it should never be performed.

The object of such an operation is to approximate the bone ends; to transform the lower end of the humerus into a wedge which is received into a V-shaped slot prepared in the upper ends of radius and ulna, fascia is intervened, the bones are fixed by kangaroo tendon, passive movements are started early. The shape of the incision into the bones makes for lateral stability. In attempting to *produce* ankylosis of flail joints we often succeed in producing a satisfactory pseudo arthrosis; when we directly aim at a pseudo arthrosis we are in danger of losing stability.

Time will not permit me to deal with stiff and ankylosed joints. I will only say that many pre-war methods have had to be discarded. War has taught us to avoid the methods of force in favor of the persuasive and the gentle.

SUMMARY

The war has taught us that a more systematic and thorough education is required in the treatment of fractures. This can only be effected either by setting apart wards for fractures under the care of men who devote real interest to the subject, or by retaining certain institutions solely for the treatment of these cases. Education is sure to be imperfect if the treatment of fractures is to remain in the hands of surgeons who take no interest. We should regard every fracture as the potential cause of disability. In England, and I should imagine to a certain extent here, the demands for beds is so pressing in our civil hospitals that a junior officer will gain no favor if fractures are admitted in numbers or are retained for long. This, after all, is only a repetition of the story of early evacuation in time of war. It has no justification in time of peace. If general hospitals are not

prepared to segregate cases of fracture, properly superintend them, and to treat them until evacuation is safe, they are far better without them, from the point of view of the surgeon and the student, and of the unfortunate victim.

Your nation taught us a valuable lesson when a committee was appointed to standardize splints, and all the surgeons were taught to master their construction and use. This again should be of value in civil life. If the simplest and best splints were standardized by a committee of experts, and their application thoroughly taught to every student it would clarify a complex problem. The student should be taught not to be out and out adherent to an operative, a fixation or a mobilizing school. He should be taught to cultivate a sense of proportion, and above all he should be taught how to make a diagnosis without first consulting an X-ray picture.

War has taught us the importance of insisting that before a man becomes a specialist he should have a sound working knowledge of general surgery. Nothing is so fatal to progress in any special branch than when, from defect of education, a surgeon is obliged to take a microscopic rather than a telescopic view of a problem. When a firm surgical foundation is acquired, he can deflect his energies with great advantage to special fields. One of the inevitable misfortunes of the war has been that able young surgeons with but little pre-war experience have graduated as excellent operators. They should, on their return, supplement their knowledge of the use of the knife by a careful study of conservative methods such as they will find in our reconstructive hospitals. The scalpel is not the surgeon's greatest asset, it may be his greatest curse. He requires a steady head even more than a steady hand. We must in future give him more liberty of action, make more use of him than we have been accustomed to in the past. His flexible mind has great potentialities. This can only be developed by giving him a fuller responsibility. It is a tragedy to see men between thirty and forty gathering the crumbs that fall from the table of Dives. The experience of age is after all only the product of opportunity. Let the young glean all that is worth gleaning from their seniors, but let us on our part offer the hand of friendship to all who strive to improve upon our methods, and value their loyalty all the more if they maintain a critical spirit.

War has done us one supreme service. It has cemented the two nations we love into a sacred bond of brotherhood. May it last in ever increasing strength throughout the ages.

CARE OF THE WOUNDED MAN IN WAR[1]

By SIR ANTHONY BOWLBY, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., London, England

THE great war has finished. The storm that shook the whole world is over, although its waves still break on many shores. The ships of state of the Allies have weathered the tempest and now lie in harbor to repair and refit. The time is ripe to take to heart the lessons we have learned, and to see that we have profited by our experiences.

It is almost a truism that the Armies and Navies of all the combatants have relied as never before on the labors of the whole civil population, and that every branch of science has been called upon to contribute in response to the call of "the country in danger." But what interests us here and now is not so wide a range of subjects as this consideration suggests, and I propose to ask you today to fix your attention on one subject alone — "*The wounded man and his wounds.*"

During the past years of war men killed in battle have been counted by the million, and men wounded by tens of millions. Never before have surgeons had to treat such vast numbers of human beings. But in dealing with a war which has raged in some part at least of every continent, except on that of America, it is evident that attention must be concentrated on some one region alone, and consequently I must perforce leave to others the campaigns in most of the theaters of war and must limit myself to the one area personally known to myself and to many of you, namely, France and Belgium.

In this area four Great Powers have shared the fortunes of war against Germany and it is not too much to say that in this area the surgeons of these powers have contributed very largely to the success which the Allies have achieved. Belgium, France, the United States, and Great Britain with the Dominions have sent many of their best to this "Western Front," and the world at large has the right to expect that it will profit by the collaboration and free interchange of ideas which have so happily characterized all our work.

But if I am asked whether this expectation of benefit has been justified, I have no hesitation in replying that far more has been learned than anyone could ever have dared to prophesy before the war. In the first place the whole practice of military surgery has been revolutionized with the cordial cooperation of the Army Medical Services, and opportunities for the thorough and appropriate treatment of wounded men, both at the front and at the base, have been provided by the military authorities, such as in 1914 would never have been granted in the army of any belligerent. The whole standard of treatment has been raised, and, whereas in the early days it was a sufficient answer to any proposal to say — "You cannot expect to treat wounds in war as you would treat them in peace" —it is now fully realized that this is exactly what you should expect and should aim at, even if you cannot always attain your ideals. I have myself constantly pointed out that, apart from motives of humanity, it pays the army and the country to care for the wounded as well as possible; it pays the army by returning men fit and able to fight, and it pays the country in saving the pensions of widows and orphans and maimed soldiers. In days when the British army was sorely tried in 1918, for want of sufficient men, it was a source of very legitimate satisfaction to the Army Medical Service that our convalescent-camps for the sick and wounded in France supplied a never-failing stream of soldiers returning to their regiments. And, as to mortality, I found on April 15, 1918, that the wounded admitted to Etaples and Camiers during our very worst week of the whole war, i.e., from March 22 to March 29, had done so well that at the end of three weeks the total mortality in nearly twenty thousand wounded men in this area was only one per cent. In the ensuing summer it was nearer a half per cent. What is the explanation of these good results? The answer is to be found in the methods we had learned for

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treating the wounded man and his wounds, for no such results were obtained in the army of any belligerent in 1914-15.

It will be universally acknowledged that the first and most striking danger to the man wounded in war is "shock," and this condition is met with in a far higher percentage of men wounded in war than in those correspondingly injured in the occupations of peace. The reasons for this are sufficiently obvious, for the man injured in the workshop or the factory or on the railroad is not suffering from want of sleep or want of food and of water. He is not unduly exhausted by physical strain or by mental excitement, and when he is injured help is at hand quickly.

The man injured in war is frequently suffering from some or all of these causes of exhaustion, and he is often thoroughly chilled after his injury through lying out in cold, wet, or even freezing weather. The "shock" of the soldier is, as a result, often quite out of proportion to the severity of his wounds, and is consequently not to be estimated accurately as true "wound shock" until these other factors have been eliminated by appropriate treatment. Unless this is kept in mind it becomes exceedingly difficult to estimate the true value of remedial measures, for it will be found in war that complete rest, plenty of hot drinks, and plenty of warmth will in thousands of cases restore, in a comparatively few hours, men who were cold and pulseless on admission to hospital. I have always been convinced that the most important of all the remedies for shock is warmth, and that nothing takes its place. The consequence in France was that when this was appreciated, and when every casualty clearing station had arrangements for warming men by the introduction of hot air under the blankets, the majority of the badly shocked men went to sleep after a good drink, and recovered with surprising rapidity.

The men who did not respond to these measures were those who were suffering from true "wound shock," and it must be constantly kept in mind that the injury inflicted by rough transport may be as potent a cause of true wound shock as was the original gunshot wound itself. It is, therefore, obvious that if this statement is as true as I believe it to be, much of the wound shock can be obviated by sufficient care in the early application of suitable splints, which should be employed in all severe injuries and not reserved for fracture cases alone, and also by the supply of well hung and well warmed ambulance cars.

It was partly by such simple and accessible methods as these that the condition of the wounded man was so greatly improved during the war, and it will be by the application in civil life of the knowledge we have gained that a like improvement will be obtained in peace.

I have been myself so convinced of the importance of care in the transport of injured men that, with the aid of the Army Medical Service and of the British Red Cross Society, I have arranged for the equipment with suitable splints of 500 motor ambulances in various parts of Great Britain, and arrangements are now being made to see that the ambulance drivers and the orderlies are as thoroughly trained in the use of the "Thomas outfit" for fractured extremities as were our orderlies at the front in France. I suggest to you that you will find similar measures of incalculable value to men injured far from surgical help in your own great country, in lumber or mining camps, or in remote farms and villages. It is quite easy to train men who have no surgical knowledge at all so that they shall provisionally put up a fractured leg or thigh much better than the best surgeon could have done it before the war, and I believe that one result of what our experience has taught us is that in every country arrangements should be made to teach how badly wounded men may be taken even for great distances without further injury being inflicted upon them by the transit.

But although so much may be done to prevent shock it must be recognized by everyone that shock and death from shock have been terribly common occurrences; and surgeons and physiologists have in large numbers availed themselves very fully of the innumerable opportunities afforded for increasing our knowledge of its pathology and treatment. It is not possible even to mention the names of all the leaders in this enquiry, but Crile and

Cannon in the American Army, and Cowell, Fraser, Keith, Drummond, and Wallace in the British Army cannot be omitted, while the experiments of Bayliss and Dale have thrown much new light on the various physiological problems.

I will not attempt to discuss the various opinions and views of the many workers in this field, but will ask you to allow me to place before you what seem to me to be the chief facts we have learned.

1. Wound shock may immediately follow a wound — "primary shock" — or may be delayed for even some hours — "secondary shock."

2. The total volume of blood in circulation is diminished, while at the same time the blood becomes concentrated — unless there has been severe hæmorrhage.

3. The loss of blood from the circulation is due either to its accumulation in the capillary area or else to the transit of its serum through the wall of the vessel—probably the latter.

4. Blood pressure is greatly reduced in proportion to the severity of the shock (or of serious hæmorrhage).

5. If a blood pressure below 60 millimeters of mercury, or a blood volume of less that 65 per cent continues for more than a very few hours, all remedial measures are useless.

6. Great loss of blood causes conditions and symptoms closely allied to those of shock.

7. Most of the symptoms and circulatory phenomena which characterize shock may be produced by toxæmias of various kinds.

8. It is probable that auto-intoxication from the products of devitalized and crushed muscle may also cause similar symptoms in some cases.

The practical deduction which is to be drawn from the consideration of our present knowledge of shock is that, inasmuch as the principal phenomena are loss of blood volume and fall of blood pressure, the obvious aim should be to restore these.

Treatment by rest, warmth, and taking of fluids is indicated in all cases, whatever more may be required, and morphia in moderate doses will be useful in allaying pain, anxiety, and excitement, and so encouraging sleep. In many cases nothing more is needed. The simplest method of increasing the blood volume is to administer fluids by the mouth, and, as all soldiers in battle areas have only limited supplies of water to drink, it should be accepted as an axiom that all wounded men always require drink as soon as they arrive at an aid post or field ambulance.

Unfortunately, many patients with really severe shock are quite unable to keep down any fluid, and in that case rectal injections are often most useful, especially when the patient has lost much blood. I believe it is true that both blood pressure and blood volume are more likely to remain improved by gastric or rectal absorption of fluid than by the intravenous administration of the same quantity. It seems clear that the direct addition of fluids to the venous blood is not so good as the making of blood serum by the patient himself from fluid absorbed through a mucous membrane. But in many cases of severe shock and in view of the fact that delay may mean disaster, it is often necessary to perform intravenous infusion as soon as the patient has been warmed and rested. We have learned that normal saline is useless for this purpose, but it is the opinion of most observers (and it is mine) that Bayliss' solutions of 6 per cent gum arabic in normal saline is of the greatest benefit in raising the blood pressure for long enough to carry the patient over the danger period.

In proportion as the shock conditions are due to excessive bleeding, infusion of blood is better than gum solution and is undoubtedly indicated; and not less than a pint should be introduced.

There is no doubt that many lives were saved by this practice, and there is also no doubt that it was not until the surgeons of the United States Army joined the British Casualty Clearing Stations in 1917, that blood transfusion became common. Its employment was subsequently utilized yet further forward, and great benefit ensued when prepared, citrated blood was sent up to the field ambulances when a battle was impending during the advance of the Allies

in 1918, for it could safely be kept for from 12 to 18 hours or more before use. I would suggest that in future sterilized gum solution should be kept ready for use by operating surgeons and by all hospitals, and also that test sera for donors of blood should be regularly stocked, so that no delay may arise in the choice of a donor for blood transfusion, for, if such treatment is necessary at all, it is certain that there will be no time to waste, as the experience of war has shown that if blood is transfused too late it is quite useless.

But if we learned much that is valuable about shock and its prevention and treatment we must realize that, after the patient had been pulled through the shock period with difficulty, it was often necessary to operate as soon as possible, and before sepsis had appeared upon the scene; so that no sooner had the patient been saved from the shock of his original injury than he was obliged to run the risk of operation shock. Still, where limbs were hopelessly shattered, or main vessels were torn, or the abdomen was shot through, etc., there was no choice left to the surgeon, who also knew that in many cases the rapid removal of a smashed limb resulted in great relief of symptoms.

But operation generally meant anæsthetics and here we were destined to learn a great deal that was new to us.

With regard to the choice of an anæsthetic agent it may be conceded at once that for all slight operations on patients in good condition "open ether" is very often quite satisfactory. But when in wintry or wet weather very many of the wounded were already suffering from a bronchial catarrh, ether was very liable to cause grave pulmonary complications, and it was not until we introduced the "Shipway apparatus" for warming the ether vapor that it could be safely administered in such cases. I would very strongly advocate that, in the future, warm ether vapor should be systematically employed as the best routine method where ether is used in civil practice, for it is not only less irritating to the lungs, it is also much less liable to cause severe vomiting.

But in cases of "shock" neither chloroform nor ether is safe, for a careful record of blood pressure during operations under ether by Major Geoffrey Marshall showed conclusively that although the blood pressure might be high when the operation was finished this was soon followed by a reactionary fall and death in very many cases.

And not only is ether not a safe anæsthetic in shock, it is also very injurious if, as is so often the case, it causes nausea and sickness in men who need every ounce of fluid nourishment that can be given, for this sickness if continued for some hours will destroy the last chance of recovery of the shocked man.

Much had been expected from the intrathecal use of stovaine, but the sudden fall of blood pressure it caused proved to be very dangerous in shock, and local anæsthesia was so tedious that it was not possible to use it in many cases when patients were very numerous. There remained nitrous oxide and oxygen. The value of this agent in shock had been conclusively proved by Marshall in 1916, and his observations showed that under its influence extensive operations could be performed without any *immediate or subsequent* fall of blood pressure, but it was not until the "teams" of the United States surgeons came up for the Passchendaele fight with plenty of nitrous oxide and oxygen that it was administered on a large enough scale by first rate anæsthetists. Its use saved many lives, and in abdominal operations the very best results of all were obtained by combining it with infiltrative anæsthesia of the abdominal wall. By this combined method the gas and oxygen required was reduced to a minimum, and the operator was not troubled by abdominal rigidity. It was by the use of this combination that Majors D. Taylor and G. Marshall at "Rémysiding" succeeded in saving 74 patients in a consecutive series of 101 operations for perforating wounds of the abdomen, and I believe that these results were the best obtained in the British Army during the war.

Very much more might be said of war anæsthesia did time permit, but I would urge that gas and oxygen should be supplied together with suitable apparatus for all the Army Medical Services of the future, and I would also press upon your attention the value of *warm* ether vapor in the prevention

of pulmonary complications. May I add further that I believe that the combination of gas and oxygen with local anæsthesia is the very best anæsthetic agent for most of the abdominal operations of civil life, and for many others also, for it causes no fall of blood pressure, it eliminates anæsthetic shock, and it abolishes postanæsthetic vomiting and all its attendant troubles. Now that more simple and safe apparatus has been invented by Dr. Gwathmey in your army and by Marshall and Boyle in ours I look to the time when no one will dread an anæsthetic or its effects. I will only add that I have seen a greater improvement in the use of anæsthetics during those years of the war than in all the preceding years of my surgical life, and also that in very many patients with completely smashed limbs it is often easy to complete the severance of the torn tissues and remove the shattered member without any anæsthetic at all.

THE TREATMENT OF FRACTURES

Let me ask you now to direct your attention for a few minutes to the treatment of fractures, for I think it is the opinion of all surgeons that here there have been great developments.

I will briefly sum up the position by saying that the fractures in France, both in your army and in ours, were treated by "extension and suspension," so that the circulation, nourishment, and mobility of the injured limb were maintained throughout as far as possible. Constriction by bandages has been reduced to a minimum, and limbs are no longer encased in wooden boxes or in plaster of Paris, and, as a result of the precautions to maintain in this way the vitality of the limb, wasting of muscles and stiffness of joints have been largely prevented.

It is greatly to be hoped that our war experiences will be utilized at home, and that all hospitals and medical schools will arrange for a much more systematic teaching of how to deal with fractured limbs, so that all young surgeons will in future realize that the so-called "setting" of the fracture should be really only the beginning and not the end of surgical treatment. And if this aim is to be achieved it will be necessary that some at least of the fracture cases in general hospitals shall be collected in "special fracture wards" equipped with the necessary apparatus for "extension and suspension," and supplied also with a mobile X-ray outfit, for there are many cases where a good result can only be obtained by frequent radiography.

Let it be fully realized that so long as the *principles* I have sketched are kept in view the details of how best to carry them into practice must be left to the skill and ingenuity of individual surgeons, and in view of the very many improvements which were daily developed by many young and keen surgeons in France, I would add: "Do not be too ready to standardize apparatus," for too early "standardization" is liable to spell "stagnation." Principles may remain while methods develop.

THE TREATMENT OF WOUNDS

Looking back to the beginning of the war it is evident that we had much to unlearn before we could learn, and there is no doubt that many of us in the British Army were too much under the influence of our South African experiences. Let me sum up these very briefly in order to try to see things as we saw them in 1914.

The South African War had been fought over a vast and very thinly populated country which was for the most part uncultivated, and whose thinly covered soil was so exposed to drying winds and burning sun that, as far as pyogenic organisms were concerned, it was practically sterile. The spore-bearing organisms of tetanus and gas gangrene were never encountered, and most of the wounds did not suppurate at all. Wounds from high explosive shells were practically unknown, and shrapnel bullets were few and far between.

There were no machine guns, and rifles were generally fired at ranges of over half a mile. The rifle bullet of both belligerents had an ovoidal shaped point, and was of an exact cylindrical form, so that it resembled a rather large trocar. The flight of these bullets was very steady, and unless they encountered a thick bone or were fired at extremely close range the damage they caused was strictly

limited to the tissues which bounded their track, and their entrance and exit wounds were alike minute. On six occasions I saw patients through whose patellæ one of these bullets had passed and had only left a hole which might have been made by a gimlet, the bone around being neither cracked nor fractured.

As a result then of the nature of the soil and the character of the projectiles the wounds we had to treat needed the minimum of surgery, and in the vast majority were best left alone to heal under a scab or blood clot. We expected something of the same kind of wounds in France, and were very rudely awakened before the war was many weeks old.

The fact was that in France everything was absolutely different as compared with South Africa. The country was thickly populated, the richly manured soil was swarming with all kinds of pathogenic organisms, enormous wounds caused by fragments of high-explosive shells abounded, and the rifle bullet was of a wedge-shape on longitudinal section, and so unstable in its flight that it was easily turned completely round by slight resistance and struck the tissues with its side or base. The consequence was that not only were the wounds highly infected by the soil, but that foreign bodies and clothing which was grossly contaminated by mud were to be found buried deep in the lacerated tissues. The wounds themselves were large and lacerated so that much of the exposed parts was partly or entirely devitalized by the smashing effect of the projectiles. Our previous experience turned out to be misleading, and we were soon swamped by tens of thousands of wounded men who developed gas gangrene and tetanus in great numbers.

It took time to get sufficient tetanus antitoxin, although the supplies from America saved many lives, but there was no antitoxin for gas gangrene, and at first we found no real remedy for it. Time and experience alone led us to the proper treatment by excision of all devitalized tissue and the careful and thorough mechanical cleansing of the wound; and it was during this period of learning and experimenting that antiseptics were given so thorough a trial, and were proved to be so valueless when employed in these grossly contaminated wounds.

The uselessness of attempting to sterilize an infected wound by the single application of a powerful chemical agent is really nothing new, and my friend Sir George Makins pointed out in his Hunterian oration of 1918 that Lister himself was quite aware of this, for he wrote: "If for example a pair of forceps is handed to the operator with the intervals between the teeth occupied by dry septic pus, and if a portion of this dirt becomes detached and left in the wound, the evil cannot be corrected by any antiseptic wash that is now at our disposal, or that the world is ever likely to see." Very striking words!

In spite of this dictum, however, some of the most eminent and famous of Lister's admirers in England were the most prominent in urging us in France to try to sterilize wounds by the early introduction of powerful antiseptic agents, and with the natural result that such measures were tried and absolutely failed. There is, indeed, now but one opinion among surgeons and bacteriologists who worked in France; namely, that *antiseptic agents are quite powerless to sterilize grossly infected wounds*, and I do not think it is necessary to impress this upon you, for your own observers have been unanimously in agreement with this view.

I have already said that the only real method of sterilizing the wounds of war as we saw them in France was by a suitable operation and the mechanical removal of all that might do harm, so that no tissue which is too badly damaged is left. The next question we had to decide was how to treat such a wound subsequently, and, as you are well aware, the answer was found in the "closure of the wound," by either "primary" or "delayed primary suture," except in those cases (1) where acute gas gangrene had already developed, or (2) where there had been long delay before the patient could be treated; or (3) where the infecting agent was a virulent streptococcus. The result was that we were able to suture within a few days, and subject to these conditions, from 70 to 85 per cent of all classes of wounds.

And we also learned very clearly both that

the results were not materially influenced by the use of any antiseptic agent and also that wounds could heal well and firmly even though they contained large numbers of micro-organisms, so long as the latter did not include virulent streptococci.

It soon became evident that the cells could destroy a considerable number of bacteria provided that the latter were surrounded by healthy living tissues and that by closure of the wound the advent of fresh infection was effectually prevented. The presence of bacteria of various kinds in wounds which nevertheless did well was recorded by observers of every nationality, and especially in the United States units by Crile, Kenneth Taylor and H. Cabot; and in the British units by Forbes Fraser, Adrian Stokes, McNee, and the workers in Almroth Wright's laboratory. In almost all regions of the body we closed wounds successfully, either by primary or secondary suture; in the head and neck, the limbs, the chest, the abdomen and the large joints, and we soon learned by experience that if patients could not be retained at the front after suffering from extensive wounds it was better to send them to the general hospitals with a packing of gauze, and let the wound be sutured without further interference after arrival. We found no advantage in using antiseptic substances with this packing, although many surgeons did employ flavine solutions or the bismuth iodoform and paraffin paste suggested by Rutherford Morison.

Much more might well be said as to details of treatment in different regions of the body were time no object, but the results obtained in the later stages of the war may be briefly summed up by saying that not only were many lives and limbs saved by wound closure, but that compound fractures healed more rapidly and with much less necrosis, joints were saved from acute arthritis, suppuration of wounds became rare, septic infection with its fever and emaciation diminished, and convalescence was infinitely more rapid. From the Army point of view, fewer beds were occupied, nurses and surgeons were spared much unnecessary work, and many soldiers were returned to their units fit and well within a few weeks instead of suffering for months from suppuration.

Surely it is evident that much of what we have learned is applicable to civil practice. Is it not certain that we shall close open wounds of the knee-joint, that drainage tubes will be much less employed, and that "delayed primary suture" will become a common method for the treatment of bad compound fractures and the lacerated wounds caused by machine accidents? The same method of wound closure by delayed suture will be found just as useful in amputations through tissues near to suppurating areas. We found it most helpful in the treatment of Syme's amputation, and Colonel Elder, when consulting surgeon at Rouen, showed me a very striking series of successful amputations by Syme's method performed upon natives of India for gangrene following frost bite, and treated by suture after an interval of three or four days. I believe that there is a wide field for the application of war methods to the treatment of the injuries of civil life, but I would emphasize that in suturing wounds after the interval of a day or two it is essential for success that *no further wound toilet is permissible*. The packing should merely be removed as gently as possible and the sutures inserted and tied.

There remains the question of the treatment of suppurating wounds. What have we learned of these? I think we have certainly learned two things: first, that it is more often possible to close them by suture than we had thought; and second, that Carrel's method is a very great improvement on the drainage tube and daily syringing.

With regard to the first: We found in France that very many wounds which were free from virulent streptococci could be successfully sutured even if they were suppurating, and Sir Berkeley Moynihan and Colonel J. Swain reported to the surgical conference in Paris that they had seen many cases of granulating wounds where satisfactory closure had followed suture combined with the use of the paraffin, iodoform, and bismuth paste. I have myself seen cases of similar successful closure of suppurating compound fractures in France, and Professor

Rutherford Morison and other surgeons have recorded many successes.

With regard to Carrel's method of treating suppurating wounds, I have no doubt at all that it has marked a very great advance. It supplies a thoroughly scientific and carefully thought out technique, and has been proved to be of the utmost value in the hands of many of the best French and Belgian surgeons as well as in British hospitals. I have seen admirable results from its careful employment, and I believe that where surgeons have had an unsatisfactory experience this has been largely due to an imperfect technique, for in many hands it has given admirable results in stopping sepsis and suppuration, and in enabling granulating wounds to be closed by secondary suture.

It is difficult to decide the rather academic question as to whether the method owes its success chiefly to the hyperchlorous solution of Carrel and Dehelly or to the method of irrigation, but I think myself that the method is more important than the particular solution.

Here again we have learned much that is useful in the treatment of the suppurations of civil surgery, for Carrel's method is not only valuable in the wounds of war, it is quite as efficacious in the treatment of an empyema or of pelvic suppuration. I have seen most excellent results from its use in large appendix abscesses on the one hand or in suppurating joints on the other, and I am convinced that it has supplied to the operating surgeon a valuable addition to his armament.

I cannot doubt that in the future the surgeon will also work more with the bacteriologist than he did before the war, for it has been by collaboration and experiment that many of our advances have been maintained without undue risk to our patients. And whatever we may have learned there is inevitably much more to learn in the near future. Let us all keep this in mind, and let us also remember that, as far as details are concerned, a too rigid standardization may be harmful. The only safe attitude is that we should be always inclined to believe that however good a method may be, it is always possible to evolve another which may be better still.

I have endeavored to point out to you in what I have said that the surgery of the immediate future may well be expected to benefit from our recent experiences; that we should improve our transport service and our first aid for the wounded in civil life; that shock can be better treated and can often be prevented; that anæsthesia can be rendered safer; that no antiseptic can sterilize infected wounds; that much more should be done for fractured limbs, that in delayed suture we have an important advance in surgical technique, and that suppurating wounds can be treated by improved methods. You are all well aware that were I able to consider in detail the surgery of the various regions, such as the head, the chest, the abdomen, etc., I should be able to record very many examples of advances in surgery, but this is not the occasion for such a discussion, and I am content to deal only with more general principles.

I cannot conclude this address without expressing to you my deep sense of the honor you have conferred upon me in appointing me to deliver it and in electing me to be an Honorary Fellow of your College. I had had but few opportunities of making the acquaintance of the surgeons of America before the war, but I have now the satisfaction of knowing that very many of them I can now call, not acquaintances, but friends.

When you came to France you came to our aid. When I was in the greatest difficulty in advising our Director-General how to arrange for the increasing demands of the surgery of the Front in the summer of 1917, my difficulties disappeared when I was able to secure your co-operation in our casualty clearing stations at the Third Battle of Ypres. I shall never forget the spirit in which you joined us there. Your one wish was to help us and our soldiers, and in so doing to learn to help your own troops later on. You were willing to sit at the feet of young "surgical specialists" of an age to be your pupils; you took your turns like the youngsters on night duty or in the reception rooms, in the resuscitation wards and the operating theaters. You were full of enthusiasm and most stimulating in discussing with us the surgical

problems of war. But more than all this — you sympathized with our soldiers in their troubles, our outlook was your outlook, and you worked hand in hand with us so that we became, like Nelson's captains, a real "band of brothers." Wherever I went during that prolonged and trying struggle toward Passchendaele I found that American, British, and Dominion surgeons had established a genuine appreciation of each other and of each other's work which will long outlast the war.

I shall never forget what you did, and in the name of the British soldier I thank you all for your help.

THE RELATION OF CANCER TO THE PROLONGATION OF HUMAN LIFE[1]

By W. J. MAYO, M.D., F.A.C.S., Rochester, Minnesota

INTRODUCTION

AMERICA is confronted by the problem of reconstruction following war. How may she best meet international competition along with failing immigration and an exodus of temporary residents who are now returning to their European homes with their savings earned in America? No one among us can be so mean of spirit as to desire the American laborer to return to prewar conditions, but rather do we all desire that the laborer and his family shall be well housed, well clothed, well fed, and that his children, the future American citizens, shall be well educated and equal to grappling with the problems of their time. By laborers I mean all those high or low who are engaged in productive employment; not only men but women who, under changing conditions in this country, have become an important part of the labor supply. America must compete in international trade with countries which, devastated by war, contain peoples willing to work long hours for small pay, under labor conditions which we hope never again to see in this country. Successful competition demands efficient production.

There must be a reduction in this country of the 200 per cent unproductive man to a minimum. Every person who is fulfilling an unnecessary function between production and consumption is a double liability, inasmuch as the labor of another is required to maintain him, and what he might produce were he profitably employed is lost. This parasitic class is a great cause of social unrest in America.

THE RELATION OF MEDICINE TO THE PROLONGATION OF HUMAN LIFE

In the work of the medical profession lies the best hope for the future. Since the close of the Civil War fifteen years have been added to the average length of human life. With present knowledge and present conditions, fifteen years more might be added to the life of man in this country within the next twenty years. It is certain that ten years will be added, at the most productive age from the standpoint of industry, and will greatly aid in maintaining our position as the most productive nation. When I was a boy it was difficult for a man of forty to find a new job, and for a man of fifty it was practically impossible. Today the older men are great assets to the country. In the prolongation of their lives, their skill and experience in their particular work count for much. They are less inflammable, they have family ties and responsibilities—they have something to lose—so that they are less under the influence of the violent agitator. If, as a nation, we advance the time of production for each person ten years, we can well afford to shorten hours of work and improve living conditions, and we shall be able to compete with those countries in which long hours and poor living conditions shorten human life, and eventually decrease production and increase social unrest.

The introduction of potable water has made prohibition possible. Prohibition will enormously increase production. In Vienna the per capita consumption of spirituous and fermented liquors was reduced 40 per cent following the introduction of a pure water supply from the mountains. The failure of Italy and France to supply potable water necessitates the continuance of wine drinking, just as in Germany the use of beer will continue. If one traces the temperance movement through the states of the Union, he finds that it was not the appeal to the self-control of man which was behind this great movement, but the advent of potable water.

Alcoholic drinks loosen the inhibitory control which civilization has imposed over the primitive impulses of man. Crime, accidents, and social diseases too often have had their origin in the abeyance, through alcohol, of individual self-control. Pure water has eliminated typhoid; wholesome

[1]President's inaugural address, Clinical Congress of American College of Surgeons, New York City, October 20, 1919.

food and better living conditions which go with reduction of poverty will check tuberculosis, and better care of focal infections in the earlier decades will prevent many deaths in later life.

THE RELATION OF SURGERY TO THE PROLONGATION OF HUMAN LIFE

The arch enemy of middle age and beyond is cancer, and our measures both for prevention and cure have not advanced in proportion to the increasing need. One woman in eleven and one man in thirteen die with cancer and this proportion of cancer deaths will be maintained in the enormously greater number of persons who reach the cancer age. We must spread more widely the knowledge that chronic irritation is the great underlying cause of the disease. Whenever a certain type of cancer exists in a race of men or in a country with great frequency as compared with other races or countries, it is due to a single cause, usually a social custom. Good dentistry has eliminated a percentage of cancers of the jaw due to the irritation of defective teeth. Cancer of the lip and tongue is on the increase as the habit of smoking is on the increase in both sexes. It seems to be a well established fact that in the countries in which the breasts are allowed to remain exposed to the air without covering, cancer of the breast is extremely rare and the incidence is in direct ratio to the amount of covering of the breast and the pressure exerted on it.

Thirty per cent of all cancers in men and 21 per cent in women are in the stomach. The influence of drinks too hot to be held comfortably in the mouth in the production of the chronic irritation which precedes the development of gastric cancer seems probable. Unfortunately, we know less about the causes of cancer of the large intestine and rectum. Diligent search should be instituted to enable us, through knowledge of local causes, to reduce the number of such cases.

Operations for cancer. The majority of cancer patients come to operation too late to be cured. We cannot always demonstrate inoperability in a given case, and therefore operation must be done in many questionable cases to give the patient the benefit of the doubt. The mortality in the favorable cases, of resection of the stomach, for instance, is low, but some of the most extensive resections result in cures, although with a greatly increased risk. The paradox of increased experience accompanied by higher operative mortality and a smaller percentage of cures is seen; the explanation lies in the increased operability. The surgeon who reports only percentages of operative death rate and of cure without stating operability, gives us little information. We found that when we operated on only about 25 per cent of the patients with cancer of the large intestine and rectum, the mortality was about 8 per cent and the cures of the patients operated on about 50 per cent for a five-year period, but only 13 of the 100 patients were cured; 75 were considered hopeless at the time of examination and were not subjected to operation. Gradually the percentage of patients operated on was increased. The mortality advanced to an average of 12 per cent; the percentage of five-year cures dropped to 37 per cent, but we had 27, instead of 13 of the total 100 patients examined, alive at the end of five years.

I have been impressed with the fact that too little attention has been paid to traumatic transplantation of malignant cells during operation. Rough handling of the growth loosens cells which may become grafted on any surface denuded of its normal covering. A considerable percentage of adenocarcinomata of the ovary is due to spontaneous grafting of cells having their origin in cancer of the stomach. These cells are grafted on to the break in the ovarian surface due to the discharge of the ovum, and the secondary infection in the ovary, by rapidity of growth, may mask the primary disease. Transplantation may occur by gravity to the bottom of Douglas' pouch, the malignant cells becoming attached to the terminal epiploic tags. This produces the typical nodules so readily noted on rectal examination, and which make possible a diagnosis of metastatic carcinoma and inoperability even when the primary focus is unknown.

In our early cases of vaginal hysterectomy

for cancer of the cervix we rarely had a cure. The carcinomatous cervix was grasped with vulsellum forceps. traumatizing the tissues during the removal of the growth, and local recurrence resulted. We then began doing all vaginal hysterectomies with the cautery knife and many five-year cures were obtained. The cautery method has a field of usefulness in selected cases. We found that the excessive dilatation of the vagina, preliminary to the use of the cautery, made many fissures in the vaginal mucosa. In two of our cases carcinoma developed in these vaginal fissures from cells deposited there, although there was no recurrence at the site of the original neoplasm.

Carcinoma of one wall of the rectum, exercising eroding pressure on the opposite wall, may cause secondary growth. In carcinoma of the large intestine, by reverse peristalsis, carcinoma cells may be carried upward and become transplanted above as well as below the original growth. In one of our cases a preliminary colostomy was performed and at the end of two weeks, while there was still a little granulating surface around the colostomy wound, the rectum was removed from behind. Carcinoma cells were evidently detached, carried upward, and deposited on this prepared field, with the result that secondary carcinoma occurred, which was confined to the margin of the colostomy wound. Operative methods must be devised that will more effectively prevent cell transplantation as well as the traumatic detachment of cancer-infected thrombi into vascular channels—a complication which frequently causes postoperative metastatic carcinoma of the liver and lungs.

Radium, the X-ray, or the cautery as an aid to surgery in the treatment of cancer. The use of various agents to extend operability, prepare the cancer field for operation, and as after-treatment to reduce the percentage of recurrences, must be further considered.

The normal cell has three periods of existence: growth, function, and degeneration. The normal cell, in the first period, undergoes division for the purposes of growth. During the period of function reproduction is most active. The malignant cell has no period of function, its entire reproductive activity is thrown into the first stage, and only the embryonic growth cell is produced The normal functioning cell as part of the community life is protected by the entire organism of which it is a part. The nervous system, the blood, the lymphatics, are all a part of this protective mechanism. The malignant cell has no such protection; it is five times as vulnerable as the normal cell and is treated by nature as a foreign body. Malignancy is the property of the cell; the stroma is not a part of the neoplasm but is the measure of nature's defense.

Malignant cells will sometimes be found encapsulated in the tissues of an operative field from which a malignant neoplasm has been removed. Occasionally through some agency such as traumatism or general disease the retaining wall breaks down, and metastasis occurs after many years of apparent operative cure. Radiotherapy destroys cells for a certain distance, but cells are sterilized at a greater distance so that their reproduction is checked, and connective tissue is caused to develop which acts as a barrier to the further extension of the malignant process. Radiotherapy often fails when malignant cells become attached to the walls of the three-coated blood-vessels from which they draw sufficient nourishment to withstand its effect.

Radio active substances give great promise for the future. I would include with radium and the X-ray, the radiant energy of heat. For some years the X-ray has been used more or less following operation and it is believed that the percentages of recurrences, for example in the skin, after operations for cancer of the breast have been materially reduced by this means. We have greatly extended the use of radium and have obtained good results in the last three years, especially in inoperable carcinoma of the large intestine and upper rectum. A colostomy is made as close as possible to the growth, and through it radium is introduced directly into the lumen of the carcinomatous area. In the stomach, by means of a Witzel gastrostomy and the introduction of a tube into the cancerous area, radium may be directly applied, and the

patient can be temporarily nourished by means of a jejunostomy.

Radium and X-ray are more or less selective in their action. Masses and bands of scar tissue are produced which delay the advance of the growth, but make subsequent late operation difficult and often ineffective. Heat is not selective, and the scar tissue resulting, while effective in preventing progress of the cancer, does not interfere so seriously with late secondary operative procedures. Radiotherapy has justly achieved a reputation in the postoperative treatment of cancer. It would appear, however, to have its greatest field of usefulness in preparing a malignant area against wound grafting during operation and its ability at least temporarily to reduce the vitality of the malignant cell. Radiotherapy whether applied as radium, X-ray, or heat, sickens malignant cells beyond the area of destruction. During this period of cell sickness their resistance is reduced and operation is most efficient, but operation should not be delayed after radiotherapy since the period of increased cell vulnerability is short and the connective-tissue development which interferes with subsequent operation is rapid. By properly combining radiotherapy with surgery, we can increase operability, lower mortality, and increase percentage of cures.

Suggestions concerning cancer research. It is probable that there is a measure of immunity against cancer in all persons, and that this is sufficiently great in some to prevent them from having cancer. I have on several occasions been unable to remove all of a cancerous growth and, to my astonishment, the patient has remained well for a term of years. A search for the cause of such immunity and a means of increasing it is greatly to be desired. The more primitive and important the function of an organ the greater its immunity. The two most primitive functions are the maintenance of the body and reproduction. The small intestine is primitive and seldom is the seat of new-growth; the large intestine has a short heredity and is a frequent seat of neoplasm. The testicle is primitive and is seldom the seat of neoplasms; the ovary is descended from the testicle, has a short heredity, and is a frequent seat of neoplasms.

The surgery of the past has been concerned largely with gross pathologic conditions. As our knowledge has increased diagnosis has improved, technique has advanced, and pathologic conditions are coming to operation much earlier. Surgery strives by every means within its power to reach pathologic processes before they have become gross, and the time is not far distant when treatment may, in some instances, be applied so early in the stage of deviation from the normal that surgery may be unnecessary.

Abstract sciences are being called to our aid, and scientific facts, apparently unrelated, are beginning to be understood in their relation to medicine. Much may be expected from bringing certain of the abstract sciences, especially physics, to aid biochemistry in giving us a better understanding of physiology and pathology.

In 1828 Brown, the botanist, pointed out that minute bodies of all kinds when suspended in gases and liquids are in constant motion. This movement of minute particles took the name of the Brownian movement. Thomas Graham, master of the mint in London, in 1861, called attention to colloids showing that they are matter in a special state of subdivision which makes each colloid particle an entity, but that except as to its physical state, the matter is unchanged. It has been shown that these colloid particles are endowed with movement and that while they are not visible they are of sufficient size to reflect rays of light, as seen in an ultramicroscope. The movements of the colloids Graham recognized as being the movements described by Brown. Physicists have now shown that all matter is in motion, and that those particles more finely dispersed than colloids have even more rapid motion, but since the tissues of the body are matter largely in a colloidal state, we are interested principally in this type of energy. In colloids there is energy, and when the colloid particles change into a less dispersed state, for instance when a cloud which is water dispersed in a colloidal state in the air gives forth rain, the contained energy of the colloid, if the change is sufficiently sudden, is shown as thunder and lightning. The tissues

of the body are in a colloidal state and retain their form and energy, while the non-colloidal elements of the blood, such as sugar and amino acids, diffuse through the tissues, furnishing food which is utilized by the tissue colloids after the manner of an internal combustion engine.

The biochemists have shown that when certain substances are in the colloidal state they are more toxic than when they are in other conditions, and this peculiarity has been attributed by some physicists to the energy contained in the colloid body. Certain substances in a colloid state are toxic, but in other states the same substances have no such property. An enzyme is believed to possess energy in part because of the great activity of its colloidal elements, and thereby to bring about chemical changes. It has been suggested that colloid represents energy in life, as radium represents energy in matter. The physical state of matter may influence those early changes which may result in cancer. The benign cystoid appendix, the escape of its colloidal contents from an aperture in the wall of the appendix into the peritoneal cavity, resulting in grafting of hypoblastic elements upon the peritoneum—pseudomyxomatous peritonitis, myxomatous peritonitis, colloid peritonitis, and eventually cancer — are a series of steps which are rather common examples of those processes which are related to the colloidal state. It might be assumed perhaps that the physical activity of colloidal particles attacks the tissues and prepares the field for grafting. Again it may change the nature of the disturbed mucous cells in the cystic contents of the appendix and thereby set in motion a series of events which result in cancer. Such changes are often seen in the ovary and not infrequently in the mucous surfaces of the large intestine and rectum or any part of the body.

Sir William Crookes, in his attempts to demonstrate the fourth state of matter, exhausted the air from a heavy glass bulb. When certain electric attachments were made, the bulb became filled with luminous matter, and, as Crookes expressed it, "actually touched the border land where matter and force seem to merge into one another." He named this luminous substance the cathode ray, composed of negative electrons, which is the fundamental conception of the X-ray. Crookes also pointed out that when X-rays come in contact with solid matter they give rise to shadows, and that the cathode rays, when outside a magnetic field, always travel in a straight line without regard to the position of the poles. The use of energy in the form of rays such as radium, X-ray, and heat are examples of biophysics in relation to medicine.

I have neither the time nor the knowledge which will permit me to delve extensively into the fields of biochemistry and biophysics. I wish rather to call attention to the contributions of the abstract sciences to cancer research and to urge more intensive study in these new fields.

THE SURGICAL TREATMENT OF EXOPHTHALMIC GOITER [1]

By GEORGE W. CRILE, M.D., F.A.C.S.. Cleveland, Ohio

THE conclusions here presented as to the surgical treatment of exophthalmic goiter are based upon my personal experience in 2,250 thyroidectomies of which 1,169 were for exophthalmic goiter; among the latter 56 per cent of the cases, or 660, were ligated. No case was rejected for operation unless it was in the state of dissolution. In the last series of 331 thyroidectomies 116, or 35 per cent, were first ligated, and no case was rejected. Among the 116 ligations there was only one death, a patient in the early stage of dissolution, who was delirious when the ligation was made. The downward course of this case was not arrested. (Fig. 1.)

The series of 1,169 thyroidectomies for exophthalmic goiter began with operations under ether alone, and with no special precautions. The mortality rate of these early cases was 16 per cent. After the adoption of anociation—nitrous oxid-oxygen and local anæsthesia with the anæsthetization of the patient in his room—the mortality rate fluctuated between 2 and 5 per cent, until by the adoption of the system of management to be described the mortality rate for all goiters among the last 331 thyroidectomies has dropped to six-tenths of one (0.6) per cent. This number includes one series of 206 consecutive thyroidectomies without a death, and 182 thyroidectomies for exophthalmic goiter with two deaths—a mortality rate of 1.1 per cent. (Fig. 2.)

By the adoption of nitrous oxid-oxygen, the use of local anæsthesia, the multiple stage operation, the exclusion of the psychic factor, and the application of the principle of carrying the operation to the patient, it seemed as if we had included every possible means of safeguarding the patient. But we still lost an occasional case as a result of postoperative hyperthyroidism. In postoperative hyperthyroidism, the cause of death is excessive chemical activity. Therefore, the urgent need in these cases is a safe means by which this excessive chemical activity may be controlled. It is known that with each degree of rise in temperature, the chemical activity within the organism is increased 10 per cent; that is, if the temperature of a patient has risen to 106°, his metabolism has increased 70 per cent. Conversely, with each degree of fall in temperature, the metabolism will decrease 10 per cent. Once convinced that this physical-chemical principle held true for hyperthyroidism, we literally packed these cases in ice and have found that this procedure acts almost specifically in controlling the destroying metabolism. The patient is covered with a rubber blanket, surrounded and covered with broken ice, and an electric fan is used to promote evaporation. In one case the postoperative temperature was 106°, the pulse rose to 200; the patient was delirious

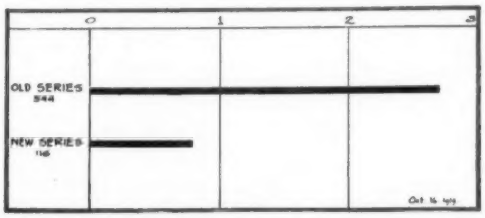

Fig. 1. Exophthalmic goiter. Reduction in mortality rate. Consecutive ligations.

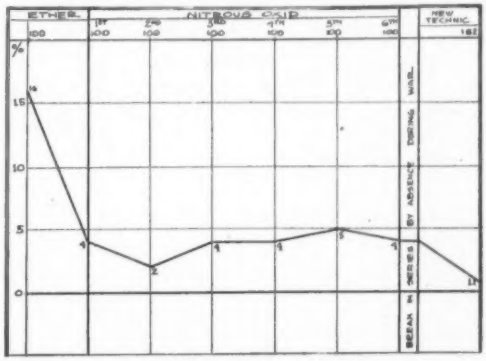

Fig. 2. Exophthalmic goiter. Mortality rate in consecutive thyroidectomies, June 28, 1906, to October 1, 1919.

[1] Presented before the Clinical Congress of American College of Surgeons, New York City, October 21, 1919.

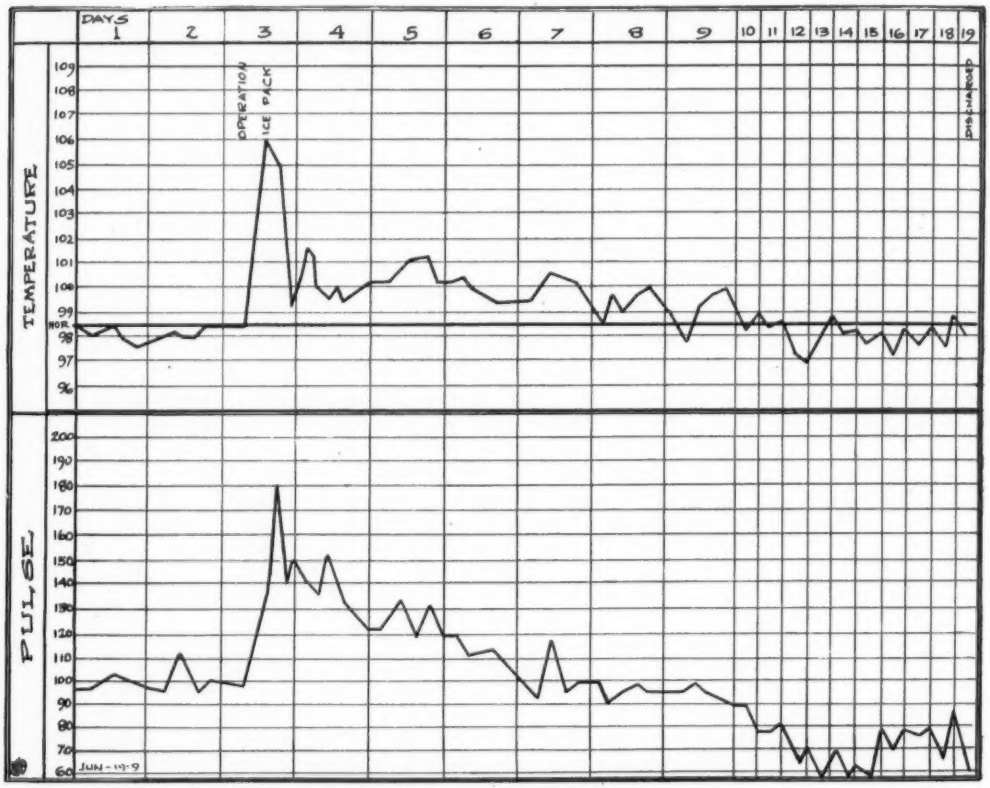

Fig. 3. Control of postoperative hyperthyroidism by ice packs.

and dying. He was packed in ice, and in two hours the temperature was reduced to 99.2°, the pulse to 140, and the patient was conscious and on the road to recovery (Fig. 3).

In grave risks the principle of the graded operation has been further extended by leaving the wound open and dressing it with 1:5000 flavine, a British war product, which holds the wound *in statu quo* for one, two or three days, as required, when further operation on the thyroid or closure of the wound is done in the patient's room.

Ligation is always done in the patient's room under nitrous oxid analgesia and local anæsthesia. In certain serious cases the lobectomy is done in the patient's room.

It is obvious that the state of the patient supplies the lead throughout; and that complete team-play among the professional, the anæsthetic, and the nursing staff is required. Indeed, these operations are not performed by the surgeon but by the hospital.

The following are the principal factors in our system of management:

1. The differential diagnosis is greatly aided by the Goetsch test and metabolism determinations.

2. The operative procedures are graded according to the severity of the disease.

3. The inhalation anæsthetic is nitrous oxid-oxygen, which is administered with the patient in bed; the operation being performed either with the patient in bed or after his transportation, under anæsthesia, to the operating room.

4. In moderate cases the entire operation may be completed at one seance.

5. In more severe cases the thyroid ac-

tivity is diminished by a preliminary ligation with the patient in bed, under nitrous oxid-oxygen analgesia and local anæsthesia.

6. In extremely grave cases it may be necessary to diminish the thyroid activity by multiple steps—ligation of one vessel; ligation of the second vessel; partial lobectomy; complete lobectomy—allowing intervals of a month or more between these stages, the length of each interval being determined by the degree of physiologic adjustment.

7. If during the operation the pulse runs up beyond the safety point, the operation is halted, the wound dressed with flavine, and the operation completed after a day or two when conditions have again become safe. In some cases, even though the thyroid has been resected, it is advisable to dress the unsutured wound with flavine and make a delayed suture in bed the following day under analgesia.

8. In certain cases lobectomy is performed while the patient is in bed and under nitrous oxid analgesia and local anæsthesia.

9. Psychic control of the patient on the part of the surgeon, the interne, the anæsthetist, and the nurse is required throughout to diminish the intense drive. An anociated regimen should be prescribed for the pre-operative, interoperative, and postoperative periods. The pre-operative and the post-operative management are of almost equal importance to that of the operation itself.

10. If, after the operation, the temperature becomes excessively high, with greatly increased pulse and respiration, the patient is packed promptly in ice.

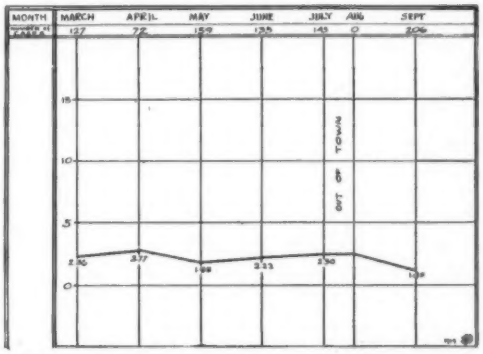

Fig. 4. Mortality rate. Total consecutive operations of all kinds, March 1 to October 16, 1919.

11. To avoid the effects of too sudden a withdrawal of thyroid secretion, thyroid extract is given the night before a lobectomy.

In this paper we have considered only the immediate surgical management of exophthalmic goiter. It should be noted, however, that the postoperative management of these cases is of equal importance.

Because of the striking benefits which follow the operation, and in view of the fact that a comprehensive surgical control yields a mortality rate of 1.1 per cent and excludes the rejection of any case on account of its gravity, we feel that the status of the surgical treatment of exophthalmic goiter is approaching the status of the surgical treatment of acute appendicitis.

THE ACUTE ABDOMEN [1]

By JOHN B. DEAVER, M.D., F.A.C.S., Philadelphia

THAT the acute abdomen is a condition calling for careful judgment and thoughtful consideration is obvious; that it occupies too prominent a place in mortality statistics is unfortunately all too true. And to our chagrin it must be admitted that among the reasons for this is the fact that too many untimely and unsuitable operations are performed in the treatment of this serious condition.

If I am right about the unnecessarily high mortality in acute abdominal conditions, may I not ask why this is so? It is in part due to the want of an intimate knowledge of living surgical pathology, in part to too great reliance on laboratory findings which do not always correspond to the findings at the autopsy *in vivo*, and furthermore to a hesitancy to resort to radical measures in the hope the symptoms may pass away under what is called conservative treatment. So they may and most often do with the passing away of the patient. Radical treatment in such instances would have been truly conservative because it generally conserves life.

The acute abdomen is not, as a rule, the result of virgin pathology. In the majority of instances it is only the outcome of a chronic pathological process which has given evidence of its presence for a well-marked period of time. How often in such cases the history reveals the presence of an antecedent lesion, such as a chronic gastric or duodenal ulcer, chronic disease of the gall-bladder or appendix, chronic pancreatitis, chronic pancreatic lymphangitis, torsion of the pedicle of a floating spleen, perforating ulcer of the large bowel; or in the acute lower abdomen chronic appendicitis, typhoid perforation, chronic salpingitis, ovarian cyst becoming twisted on its pedicle, chronic intestinal obstruction, as for example, circular carcinomatous compression of the sigmoid flexure, pelvic lesions or hernia of long standing, possibly incarcerated, or failing such definite conditions, there have been symptoms which to everyone acquainted with surgical disease of the abdomen should have pointed the way to surgical treatment.

Occasionally the acute abdomen results from conditions not easily recognized by even the most astute. Among such may be mentioned mesenteric thrombosis, acute obstruction due to internal strangulation by an unusual formation, such as a diverticulum, obstruction in an internal fossa, or a congenital hole in the mesentery or in the diaphragm. The following case illustrates an instance of obstruction through a congenital hole in the mesentery.

While cranking a Ford automobile Mr. — was suddenly seized with acute abdominal pain, necessitating his being placed in bed where he remained for several days, during which time he was under the care of the family physician. The pain subsided and recovery was prompt. Six months later, when again cranking his automobile, he suffered the same set of symptoms, which this time, however, did not disappear. This man was brought to the hospital under my care in a dying condition. No operation was performed. At postmortem was found a strangulated gangrenous coil of intestine through a congenital hole in the mesentery.

Infarct of the spleen causing acute abdomen I have seen upon more than one occasion. As to the reduction of a strangulated hernia *en masse*, I have operated upon a number of such cases. This condition is the result of injudicious prolonged taxis. Should not reduction by taxis of an irreducible hernia be delegated to the practice of the mediæval ages?

The more common of the causes I have mentioned should be recognized if our patients are carefully studied and examined and our faith has not been perverted, i. e., if we do not entertain the foolish belief that chronic ulcer, chronic gall-bladder disease, chronic pancreatitis, etc., can be cured by medicine, diet, visiting one of the famous springs, taking a rest cure, etc. This is a perverted faith, one that courts disaster, and places the subject of this pathology in constant danger.

[1] Read before the Clinical Congress of American College of Surgeons, New York City, October 23, 1919.

Again, not infrequently we have an acute abdominal condition following upon operation for relief of an acute or chronic surgical lesion. Such acute complications are intestinal obstruction, secondary abscess and peritonitis. The difficulty at times of being certain of the diagnosis and furthermore the fact that secondary or residual abscess formation may present two groups of symptoms or signs—those of abscess and those of intestinal obstruction—is appreciated by all who treat many acute intra-abdominal infections.

Still another division of the subject, the traumatic acute abdomen, affords many examples of difficult diagnosis. When a penetrating wound exists the indication is clear. Every abdominal wall which shows a penetrating wound, whatever its location and whatever the agent, should be opened. It is true that a small percentage of cases in some miraculous way will escape perforation of any part of the intestinal tract or damage to any essential viscus. But the majority show perforation of viscera, lacerations, hæmorrhage which urgently need direct treatment, although clinically there may be no evidence of serious injury. I have experienced cases where operation revealed complete section of the small bowel although the patient who had been run over across the abdomen by a heavy vehicle, showed no alarming symptoms nor any external evidence of injury.

Similarly severe blows on the abdomen, or a fall on the abdomen or the loins, or crushing accidents by wheels or between cars, etc., should bring to mind one of the various subcutaneous injuries that not infrequently occurs. In these cases it is better to open the abdomen on suspicion and find nothing, than to wait for an assured diagnosis of hæmorrhage or perforation. The man who is not more concerned about his patient's life than about a correct pre-operative diagnosis has a wrong point of view, to say the least.

Perforations of the gastro-intestinal tube are usually easy to diagnose because of the intense and sudden pain and the early board-like rigidity to which they give rise.

But in such insidious varieties of perforation as those occurring in typhoid, particularly the ambulatory type, or the perforation of an unsuspected ulcer of the colon, an exact anatomical diagnosis often cannot be made in time to save the patient's life. The important point is to recognize the presence of an acute abdominal catastrophe, and let the exact diagnosis follow upon the revelations of the aseptic scalpel.

The earlier the acute abdomen is seen the more confident can one be of the diagnosis, and the earlier suitable treatment is instituted the more favorable will be the prognosis. Of course by suitable treatment I mean surgery.

There are, to be sure, certain acute conditions of the abdomen in which surgery is not indicated and it is these that I place among the "untimely" operations which swell our mortality lists. Prominent among them are acute dilatation of the stomach, which to my way of thinking is not surgical. Whenever I hear of operation for acute postoperative gastric dilatation I cannot help feeling that the surgeon is ignorant of the rudiments of postoperative treatment of abdominal cases. Acute gastro-enteritis may simulate appendicitis and too often is operated upon with fatal results. A more frequent error, however, is made in regarding an acute appendicitis with peritoneal irritation as enteritis, and deferring operation until too late. The differentiation requires experience and diagnostic acumen but it can and should be made before resorting to operation. Pneumonia and diaphragmatic pleurisy causing upper abdominal rigidity and referred abdominal pains should be kept in mind since operation, especially anæsthesia, is particularly unfavorable to such cases. The gastric crises of tabes have also been a source of many mistakes in diagnosing the acute abdomen.

However, after considering all contra-indications to surgery and all conditions which simulate acute surgical conditions of the abdomen the greatest toll in lives is exacted as a result of delay in diagnosis and in instituting proper treatment. The reduction of the period between onset and operation is the prime factor. It cannot be too often repeated that during this period the essential point is diagnosis and not treatment. If treatment there must be at this time, and we

are not blind to the fact that the physician feels the strong pressure of the patient and the family to be doing something, the physician should be sufficiently cognizant of the real issue and sufficiently resourceful not to be deluded or forced into doing that which will endanger the certainty of the diagnosis or unfavorably influence the course of the disease (i. e., giving a purgative). I hail the opportunity of censuring this cursed practice. The doctor and the laity also know the harmful possibilities of the purgative. Would that my voice were strong enough to penetrate to every home in the world, and if heard there, my advice were heeded, in order that this malicious practice might be delegated to the oblivion it deserves. Mothers and all who use the family medicine chest must be made to realize the danger of using a purge in an acute abdominal crisis. In these conditions it should never be used except upon prescription by a doctor who himself is informed as to its dangers. "Evil is wrought by want of thought as well as want of heart." Here is a great field for propaganda and we are not doing our full duty unless we throw our weight into an educational campaign against indiscriminate purgation.

The danger of giving morphia before arriving at a diagnosis is, I believe, well understood and it is only the densely ignorant and the incorrigible who persist in this misuse of narcotics. The purge belongs in the same category since it is even more deadly than the opiate.

Are all those who insist upon purgation for the relief of an abdominal crisis, unaware of the advantages of the stomach tube as a means of forestalling a diffuse peritonitis in the lower abdomen? It would seem so, indeed. But judgment is required in the use of this instrument, for in the presence of perforation it is, of course, very dangerous.

Once the case is adjudged surgical and passed over to the surgeon, he finds himself saddled with a heavy responsibility; namely, when to operate. In obstructive conditions there is never anything to be gained by delay; the same is true in the presence of a continuing hæmorrhage into the abdominal cavity, as well as of the early stages of perforations into the peritoneal cavity. The nicest discrimination is demanded when dealing with inflammatory conditions involving the peritoneum. Diagnosis is essential in order to indicate treatment along lines best calculated to bring about recovery.

But in the type of acute abdomen that is amenable to surgery, early intervention, I need hardly tell you, is the best possible procedure. In this way only can we hope to prevent peritonitis, for finally whatever the origin of the acute abdomen, it is the peritonitis that kills. After peritonitis has once developed, especially if allowed to become diffuse, the more obscure will be the diagnosis and the greater the risk to life.

What more successful way is there of encouraging diffusion of a peritonitis than the giving of aperients or purgatives, in fact, internal medicine of any kind? I am sure that many of you have had the same experience that I have in being called in to cases that have been so successfully (?) purged and have subsequently developed a beautiful case of diffuse peritonitis, and then you are asked to undo the mischief by performing a miracle. It is flattering to the surgical profession to be credited with such miraculous powers, but there are few, if any, who can "call the bluff" in the presence of a diffuse peritonitis.

In practically all instances the type of peritonitis seen is due to the colon bacillus. While the colon bacillus is not necessarily the first micro-organism on the scene it is the organism very frequently met with in the majority of cases. In very early cases, the result of gastric or duodenal perforation, the fluid poured out into the peritoneal cavity is sterile; therefore, the results in very early operation are so successful. To illustrate this point I may recall my own statistics of 52 operations for this type of acute perforation, with one death. The fatality occurred in a patient sick several days, in whom was found in addition to the perforated duodenal ulcer a belly full of pus. In early acute perforations, cultures of the opening in the stomach and jejunum in the making of a gastro-enterostomy rarely if ever are other than sterile.

The variety of the peritonitis depends entirely upon the viciousness of the organism, the length of time that has elapsed since the

onset of the disease, and the resistance of the patient.

In the very early cases of the acute abdomen due to perforated duodenal or gastric ulcer, peritonitis is usually not at all pronounced—in the later cases it is circumscribed and diffuse. In the acute upper abdomen caused by acute cholecystitis, perforation of the gall bladder, acute pancreatitis, etc., the peritoneal inflammation appears early, and is at first circumscribed, but usually by the time the surgeon sees the patient it has become diffused. This is equally true of the acute lower abdomen, as for example, in ruptured extra-uterine pregnancy, where peritonitis, if it appears at all, does not set in until late in the stage. On general principles it may be said that in the acute abdomen with diffuse peritonitis, in the absence of a reliable history, or a reasonably sure diagnosis, and of a localized point, it is the part of good judgment to defer operation; treating the patient by strict anatomic and physiologic rest, or, as it is called at the Lankenau Hospital, regulation.

In the circumscribing, the circumscribed or the localized peritonitis with definite knowledge of the point of origin of the peritoneal inflammation, operation is comparatively, if not entirely, safe, depending wholly upon the proper technique, of course. Those who do not freely use gauze pads and gauze sponges (liberal size) in the protection of the surrounding peritoneum will expose the patient's life to greater risk than if the condition had been left to nature alone, and will probably have an uncalled for mortality. While I appreciate that all of my colleagues do not agree with me in this statement, nevertheless I am satisfied that I am correct in my stand.

The three dependable conditions necessary for the determination for or against operation are: first, experience; second, the interpretation of a carefully elicited history, although not feasible in all instances on account of the inability of the patient to express himself owing to great suffering or poor mentality; third, careful examination.

The value of experience can be disposed of in a few words, knowledge gained by observation at the bedside and at the operating table. Interpretation of a carefully elicited history is the pivot around which the diagnosis will be developed. Personally I attach more importance to a carefully taken history followed by careful study of the same than to anything else. I am sure I do not stand alone in this respect. In my affiliations with my house staff I have always laid great stress on this as one of the most important points in their training; a laborious part of their duties, I admit, but if properly and conscientiously carried out must necessarily be fruitful of results. It goes without saying that the examination of the patient must be given equally careful attention. The various laboratory methods of examination to which we have recourse and which are so useful in chronic illnesses, are, with few exceptions, not applicable to acute abdominal conditions. But if properly correlated and interpreted there are some which, in a small percentage of cases, are of value. Particularly is this true of the complete blood count. In passing I may say, that I never accept anything but the complete count, the leucocyte count alone does not satisfy me. At the same time, I may also say that I do not attach the same importance to the blood count as many others do, because I have so frequently had occasion to question its value. For example it does not always show the presence of pus. On the other hand, a high white count, as we all know, does not necessarily indicate pus. I have on numerous occasions been prevailed upon to operate or to support an opinion in favor of operation merely on account of a comparatively high leucocytosis, which to the attending physician indicated pus but which to my mind did not, and at operation my opinion was supported. How often have I known the hæmatologist to be the constant companion for several hours of the patient supposed to be suffering from a perforated ulcer, waiting for a rise in leucocytosis before agreeing to operation; a pitiful commentary upon the doctor's judgment in a case where early operation is so essential. The blood count is valuable, not as a substitute for clinical experience, but as an aid to it. That which I regard and have always taught as more reliable than a high

leucocyte count in determining the presence of pus is exquisite tenderness to touch. It is this sense of touch that many doctors, including surgeons, fail to acquire in spite of life-long practice.

In the decision whether and when to operate we must remember certain facts in the natural course of abdominal inflammations, namely:

All perforative inflammations tend to generalize.

Appendicular inflammations have a strong natural tendency to localize and so do cholecystic and pelvic inflammations.

Generalization in these cases is usually the result of improper treatment.

The principles which favor localization are now well known. Cases in the act of generalization may usually be induced to localize by proper treatment. The ideal treatment for all lesions which act by setting up peritonitis is to operate before the infection has established an independent footing in the peritoneal cavity. After the early and most favorable moment has passed the best time for operation will depend on the peritoneal process in the individual case. As already stated perforative accidents permit of small hope of localization, if any. Therefore, immediate operation yields the highest percentage of recoveries. Cholecystic and pelvic inflammations usually localize, and rather than operate in the presence of an acute, diffusing peritonitis with risk of spreading the infection to areas of peritoneum yet uninvolved, it is preferable to await further localization, and increase of the patient's resistance to the infection. In appendicular peritonitis the clinical evidence of the extent and severity of the peritoneal infection must be the guide. In localized peritonitis, whether free or confined, operation may be undertaken at once. In widespread involvement of the peritoneum with a severe infection, as manifested by marked tenderness and rigidity of the greater part of the abdominal wall and evidence of marked systemic absorption, it is safer to adopt the plan known as the Fowler-Ochsner-Murphy treatment and await localization. In spite of much that has been written and said upon the subject I am sure this is not generally accepted and applied and many lives are thereby lost. If ever there was a true word spoken it was that of the late Maurice Richardson, who said of these cases that they were "too late for an early operation and too early for a late operation."

Early operation refers to the stage of the disease and not to the time the patient is seen by the surgeon. I grant that it oftentimes takes courage for the surgeon to stay his hand. The physician, the family, and perhaps the other surgeons of the hospital or the community press for immediate operation. If the surgeon operates and the patient dies it is attributed to the disease. If he delays and the patient recovers it is not certain that recovery would not have ensued with earlier operation. But if unluckily the patient dies, as a small percentage will, the surgeon may find his delay blamed for the outcome. We should as a body stand behind the man who in these cases intelligently and conscientiously withholds his hand and waits for the favorable moment. Although in the minority, this type of cases furnishes a large part of the mortality of acute appendicitis and therefore is of relatively great importance.

Were there time I would like to elaborate certain other of my beliefs in the treatment of the acute abdomen, such as immediate operation and efficient drainage in acute pancreatitis, the efficacy of gastro-enterostomy as a primary operation in the treatment of perforated gastric or duodenal ulcers, the greater rationality and safety of the extraperitoneal incision in appendicular abscess, the folly of insisting upon always removing the appendix at the primary operation in such cases, the necessity for the use of gauze within the abdomen for the safe operative handling of infective conditions. These and many other questions I mention merely to call attention to the fact that even in this seemingly hackneyed subject, much that is important and life-saving has not as yet been thoroughly standardized.

Here is a field for research, quite as important, quite as dignified, quite as profitable as much that I observe as less worthily bearing the name of research.

EMPYEMA

With Particular Reference to Its Pathogenesis and Treatment[1]

By ALEXIS VICTOR MOSCHCOWITZ, M.D., F.A.C.S., New York
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A KNOWLEDGE of the pathology and pathogenesis of empyema is of fundamental importance in order to understand the principles underlying its treatment. An extensive operative and autopsy experience as a member of the Empyema Commission has helped me considerably to clarify my notions of the pathology of empyema, and has profoundly modified my views concerning the treatment. I shall not enter at great length into the hitherto accepted views concerning the pathogenesis of empyema, except to say that the common understanding hitherto has been that the pleura becomes infected by contiguity from the inflamed lung. This view has not appealed to me for two reasons. My first objection is that this mode of infection does not occur in any of the other closed serous cavities of the body. Take the peritoneum, for instance, and its most frequent source of infection, the appendix. Every surgeon with any experience knows that a diffuse peritonitis rarely if ever occurs unless there has been a perforation of the appendix, or its walls are so necrosed as to permit the easy transmission of bacteria into the peritoneal cavity. This is likewise true of the other hollow viscera of the abdomen. Reasoning by analogy, therefore, it is difficult to understand why the pathogenesis of infection of one serous membrane should be different from that of another. My second objection is that infection of the pleura by contiguity would presuppose a direction of the lymph current opposed to that demonstrated and accepted by physiologists and anatomists. To obviate this, a double set of lymphatics has been assumed, one passing from the hilum to the pleura, the other, passing in the reverse direction. This contention, however, is only a hypothesis and not a fact.

It has seemed to me, therefore, that upon theoretical grounds alone a different pathogenesis than that of contiguity is necessary to explain purulent infections of the pleura, and it has appeared to me to be very probable that gross contaminations of the pleura are the result of a focus in the lung, just as is true of similar infections of the peritoneum. On the constant lookout for such findings I was not at all surprised many years ago to find at autopsy an empyema that had resulted from a rupture of a small subpleural pulmonary abscess. I wondered whether this was not the common rather than the exceptional cause. As operation did not permit of sufficient exposure to demonstrate such a pathogenesis, it was necessary to seek a confirmation of our belief in autopsy material. Such material became available *en masse* at Camp Lee, in the spring of 1918, and in a series of perhaps three dozen autopsies, we were able to demonstrate in a great many instances one or more subpleural abscesses, some of which had perforated into the pleura. Additional corroboration of this pathogenesis was furnished by the influenza epidemic at Camp McClellan during my incumbency as chief of the surgical service. Lieutenant Colonel E. K. Dunham, who was associated with me on the empyema commission, again demonstrated a perforated subpleural abscess in every case of empyema that came to autopsy.

The localization of the empyema depends entirely upon the situation of the ruptured subpleural abscess. If, as usual, the empyema is a general or diffuse one, the abscess is usually located upon the convex surface of the lung. If the abscess is located in a fissure, an interlobar empyema results. When the abscess is on the mesial aspect of the lung, there are retrosternal pus pockets between the lung and the mediastinal pleura. The latter were more common in the earlier streptococcic epidemic than in the later influenza epidemic period.

As additional and perhaps obvious proof that ruptured subpleural pulmonary abscesses

[1] Presented before the Clinical Congress of American College of Surgeons, New York City, October 21, 1919.

occur in empyema is the frequent experience that irrigation of empyema cavities with irritating solutions, such as Dakin's solution, results in coughing and choking, showing that communications exist with a bronchus. This perhaps explains why in former years irrigations of empyema cavities with even bland solutions were considered impracticable. Such communications are furthermore often demonstrable by bismuth X-ray examinations I believe these communications exist in every empyema; if small, they heal promptly; if large, they may be the cause of considerable difficulty during the treatment.

I need hardly dilate upon the fact that smaller and larger abscesses occur not only beneath the pleura, but well within the parenchyma of the lung in pneumonias, especially in those of the streptococcic variety. If small, they may be absorbed; others rupture into a bronchus; if the infection becomes attenuated, they become remediable by operation; usually, particularly if they are multiple, they cause a fatal sepsis. The subpleural varieties offer perhaps the most favorable prognosis, because at worst, they form an empyema by rupturing into the pleural cavity. When they do, the rapid development of empyema is, I believe, hastened by the presence of the small amount of serous fluid in the pleural cavity, which is present in every case of diffuse pneumonia.

The analogy between infections of the pleura and of the peritoneum is therefore remarkably complete. Unruptured infections within the abdomen also cause serous exudates, which, if uninfected, become absorbed. The one important physiological difference between infections of the pleura and peritoneum is the greater and constant mobility of the lung, as compared to the sluggish peristalsis of the intestine, so that adhesions are less liable to form; a free serous pleurisy is, therefore, the rule.

When now the serous pleurisy is converted into a seropurulent or purulent exudate, encapsulation occurs just as in the peritoneum, and is due to a deposit of fibrin on the periphery. The encapsulation also, as in the peritoneum, may be diffuse, localized, or multiple. Owing to the recumbent posture, the fluid usually collects in the supradiaphragmatic and posterior portions of the thorax, giving rise to the most common form of empyema. Isolated and localized forms, however, are frequent findings, and multiple encapsulations are not uncommon.

The important point to remember, especially in reference to treatment, is that whereas a serous or seropurulent pleurisy is always free, a purulent pleurisy is nearly always encapsulated. The encapsulation may enclose an extensive area, almost the entire pleural cavity, but at some line or another, adhesions between the parietal and visceral pleura are nearly always found. An absolutely free empyema occupying the entire pleural cavity, is, in adults at all events, rarely found.

TREATMENT

Primarily I wish to emphasize that empyema, in the stage in which frank pus is obtained by aspiration, is already an end product, the terminal event of an infectious process, in which the first stage is a pneumonia with a small serous pleurisy, and the second stage, a pneumonia with a greater exudation of seropurulent material. The treatment of empyema really begins in the latter stage, so that in this disease as well as in all acute surgical infections, an early diagnosis is of prime importance. Speaking again in terms of analogy, it would be equally as logical to begin the treatment of appendicitis only when an abscess is formed, as to initiate the treatment of empyema only when the exudate has become manifestly purulent. It was not merely the observation of empyemata *en masse*, but the opportunity to witness the development of an empyema from its very incipiency, that made my military experience in this disease of so much value to me.

I have therefore divided the subject of the treatment of empyema into three stages: (1) the formative stage, (2) the acute stage, and (3) the chronic stage.

1. TREATMENT OF THE FORMATIVE STAGE

The formative stage of an empyema begins with the rupture of the subpleural abscess. There ensues promptly a rapid increase of fluid, and the conversion of the serous into a

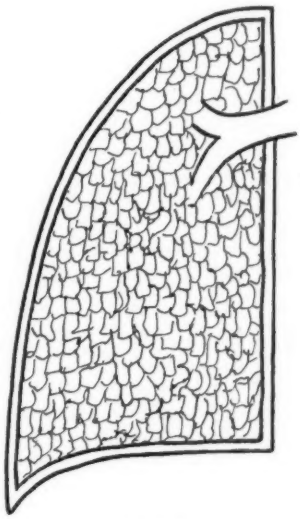

Fig. 1

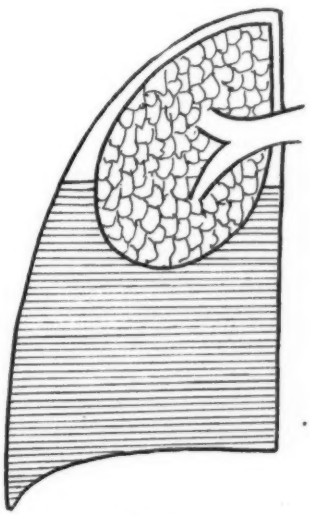

Fig. 2

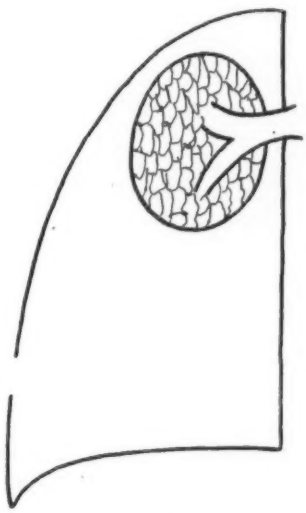

Fig. 3

Fig. 1. Diagram representing one-half of the normal thorax.

Fig. 2. Fluid collected in the dependent portion of the pleura crowds the lung upward and toward the vertebral gutter.

Fig. 3. Pneumothorax following a large thoracotomy.

seropurulent exudate. It appears to me that the rapidity of the formation of this exudate, as well as its amount, depends somewhat upon the nature of the infecting organism. In the epidemic caused by the streptococcus hæmolyticus, the fluid developed and reaccumulated much more rapidly than in the later influenza epidemic.

During the formative stage the patient is suffering from a number of things, for each of which treatment is indicated.

1. *The toxæmia.* This brings in its train a tremendous loss of nitrogen. This observation and its therapeutic importance has been made the subject of an exhaustive study by Captain Richard Bell (1), of the empyema commission. To replace this loss, the patient must be fed on a diet rich in calories. Clinical observations have corroborated the great value of this measure.

2. *The pneumonia.* I shall not enter into the treatment of this complication, because it is entirely a matter for the internists.

3. *The presence of fluid in the pleura.* I purposely avoid the word exudate, because I am now referring entirely to the mechanical effects of the fluid itself. These mechanical effects may be deleterious for three reasons: first, from compression of the affected lung; second, by pressure upon the mediastinum, and compression of the uneffected lung; and third, and most of all, by pressure upon the heart, and consequent kinking of the great vessels. It is for this reason that left-sided exudates are borne less well than those on the right.

To relieve these mechanical effects of large exudates, we resorted to the simple device of aspiration with an apparatus that does not permit the entrance of air.

It was truly remarkable to witness the almost immediate benefits of this measure. The patients were more comfortable, the dyspnœa was less, the cyanosis was not so marked, and the pulse improved in quality. Aspiration was repeated as often as the fluid reaccumulated in amounts sufficient to demand it; in some instances, especially in the streptococcic form as often as every twelve hours. In a few instances aspirations were even curative.

The question may now be asked, Why

was not an early thoracotomy done? On theoretical grounds, such an operation might obviate both the mechanical and toxic effects of the exudate. Practically, however, an early thoracotomy is absolutely contra-indicated, and for the following reasons: I shall elucidate my argument by first describing the pathogenesis of pleural exudates.

A vertical section of one-half of the normal thorax may be represented as in the diagram, Figure 1. As is seen the lung entirely fills the pleural cavity; the parietal and visceral pleura are in contact, being separated merely by a very thin layer of fluid.

If an exudate or transudate forms, the fluid, being heavier than the air containing lung, collects in the dependent portions of the pleura, and crowds the lung upward and toward the vertebral gutter. This is represented diagrammatically in Figure 2. This is what usually happens in pleurisy with effusion, in pleural transudates from cardiac or kidney disease, etc.

Suppose now that a subpleural pulmonary abscess ruptures, and an early empyema develops. There is a sudden increase in the amount of exudate, and a corresponding aggravation of symptoms. If a thoracotomy is now performed, the fluid suddenly escapes, and there is an equally sudden inrush of air, followed by an immediate collapse of the lung. This is illustrated in Figure 3. The occurrence just related is immediately followed by a fluttering of the as yet uninfiltrated mediastinum, impairing still further the action of the heart. Finally, if the patient survives, the mediastinum becomes fixed with the convexity toward the unaffected side. This condition is represented diagrammatically in Figure 4. (In parenthesis I merely wish to mention, that these observations upon pneumothorax apply only to large thoracotomies, and not to instances in which the opening is of smaller size than the chink of the glottis.) The pathological physiology of pneumothorax has been ably investigated by Garre and Quincke (2), and by Graham and Bell (3) of the empyema commission.

Putting theory aside, however, early thoracotomies are attended by a terrible mortality, as the statistics in our military camps during the epidemic of 1917 and 1918 woefully testified. Early operations were probably prompted by the enthusiasm of both internists and surgeons, who for the first time saw empyemata in large numbers develop under their very eye, and felt that early operation, which in other suppurative surgical affections is a great desideratum, would give similarly brilliant results. It was only when frightened by the formidable mortality that a halt was called on early operations, and the statistics improved. The patients died not only in large numbers, but promptly after the operation. When we consider that these operations were done upon a patient who was at the same time sick unto death with an active pneumonia, it is not surprising that the mortality was so large.

Another but less important contra-indication to early operation is the fact, that even if the patient survives, the lung becomes fixed in its collapsed position by adhesions, so that a huge empyema cavity results which takes an interminable time to heal.

To sum up, the treatment of empyema in the formative stage resolves itself to the formula *nil nocere*. The only surgical procedure indicated is aspiration of the chest.

II. TREATMENT OF THE ACUTE STAGE

When the seropurulent fluid changes into pus, adhesions form between opposing surfaces of the pleura. A cross section of the chest in such a condition is represented in Figure 5. These adhesions are important, because they anchor the lung to the parieties. The thorax therefore can now be opened without causing collapse of the lung. A cross section of the thorax after opening is represented in Figure 6. I am speaking now only of the commonest form of empyema, namely those situated in the supradiaphragmatic and posterior portion of the chest. Slight variations obviously occur in empyemata in other situations, but the underlying principles remain the same.

I do not know just when these adhesions form; the important point is that I have practically always found them when the chest contains frank pus; so that, I repeat, nearly every empyema is an encapsulated one.

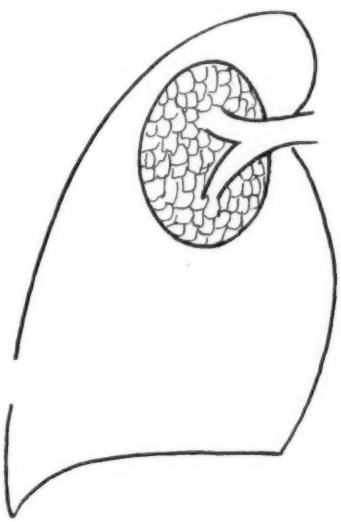

Fig. 4

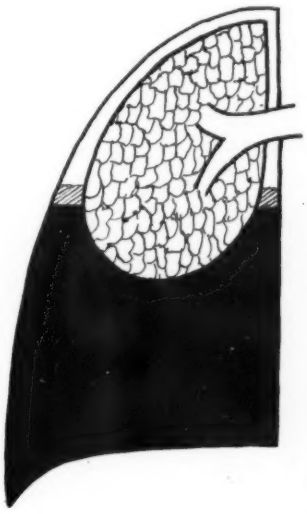

Fig. 5

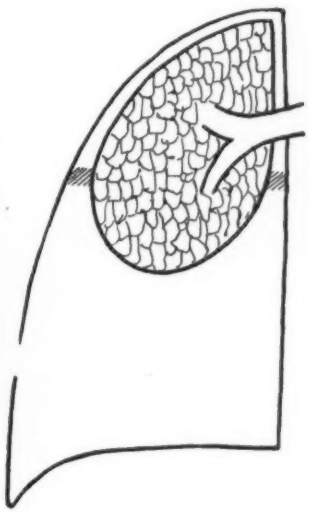

Fig. 6

Fig. 4. Cross section of the chest showing pneumothorax with mediastinum fixed with convexity toward the unaffected side.

Fig. 5. Cross section of the chest showing adhesions between opposing surfaces of the pleura due to the change of the seropurulent fluid into pus.

Fig. 6. Cross section of the chest showing opening in chest wall and evacuation of pus.

Furthermore, the patient at this time is in a much improved general condition; the pneumonia is over, and the general toxæmia has subsided. We have nothing to contend with now but the empyema, which causes symptoms from absorption of toxic material and from the mechanical effects of the fluid alone. The dangers from absorption, have, I believe, been hitherto greatly exaggerated, and while I do not advocate needless delay in performing a thoracotomy, the necessity for this operation is by no means urgent. Indeed, the only indication for urgent thoracotomy is in those exceptional cases, in which a pulmonary abscess, directly in communication with a large bronchus, ruptures into the pleura. There is thus formed an acute hydro- or pyopneumothorax under extreme tension, due to the continuous escape of air into the pleural cavity. The condition is diagrammatically represented in Figure 7. These patients suffer intensely from dyspnœa, and as the lung is already collapsed, no harm can be done by an early thoracotomy to afford relief.

The operation of thoracotomy for empyema is extremely safe. It consists simply in evacuating an encapsulated abscess lined by a thick pyogenic membrane. I shall not describe the details of the operation; I have described the procedure fully in a previous article (4).

The after-treatment is carried out upon the lines of the Carrel-Dakin method; the details of which have been fully described in the article previously mentioned. I again wish to emphasize that success depends upon its correct application. Those who deprecate its value in empyema, I am convinced, fail to use it correctly. There is nothing magical in its effects and it can never supplant good surgery, but I regard it as the most valuable adjuvant in the treatment of empyema.

III. TREATMENT OF CHRONIC EMPYEMA

In view of the experiences which I have gained, particularly during the past two years I have a certain diffidence in defining the word "chronic" as it bears upon a case of empyema. Formerly, a case of empyema which did not heal, or which lasted a long

time, and which usually required a second operation for healing was considered chronic. I do not consider this definition a very happy one, for reasons which will become apparent.

My conception regarding the manner in which an empyema heals has undergone a very radical change since my recent experience. Formerly I was under the impression that an empyema healed in only one way, namely by a process of obliteration of the pleural cavity, which in turn was caused by a gradual expansion of the lung, and the formation of adhesions between the visceral and parietal pleura. Only when the entire affected pleural surfaces became adherent did the drainage opening close. This is the only method of healing that was known up to 2 or 3 years ago, and may for that reason be called the "classical" method.

It has been stated that a properly drained empyema, even without the use of any antiseptics, sterilizes itself, but I have never found this to be the case; on the contrary have found numerous bacteria up to the very moment of final closure. When a cavity has persisted, I have observed, that the drainage opening does not show the slightest tendency to close; on the contrary in spite of earnest prayers and perhaps extensive operations, it has failed to close in many instances.

During the past three years the following variations in the method of healing of an empyema have been encountered:

1. The far-reaching observations at the War Demonstration Hospital of the Rockefeller Institute have taught us that empyema cavities can be rendered bacteriologically sterile by means of the Carrel-Dakin treatment, and when sterile, the drainage opening can be closed by secondary suture. According to the reports from the Rockfeller Institute, a definite cure results in about 75 per cent of the cases. Personally I believe that recurrence follows in a certain percentage of these "cured" cases; but there is no denying that a real cure follows in some cases. I am not aware that the method of healing has as yet been described by the originators of the method. My own observations in a few cases have led me to the conclusion that the cavity heals by the absorption of the sterile exudate that fills the cavity after closure of the wound.

2. During my stay at General Hospital No. 12, I had an experience which threw a flood of light upon my speculations as to the closure of empyemata. An empyema, treated by the Carrel-Dakin method had been finally allowed to heal. About one month after healing, Franklin A. Stevens, my colleague upon the empyema commission, found upon routine physical examination, which was subsequently verified by X-ray examination, that the patient had a definite pneumothorax. I watched this case with great interest and care. An occurrence of this nature was unknown to me, and I confidently looked forward to a reaccumulation of the pus. The unexpected, however, happened; not only did no reaccumulation occur, but the pneumothorax disappeared and was replaced by the expanding lung.

3. The occurrence in the case just related made me think very hard. It gave me the clue that I needed. Whereas up to that time operations upon cases of chronic empyema were of almost daily occurrence with me, I immediately ceased all further operating, and merely proceeded with the intensive sterilization of the cavity. When sterilization was complete, all treatment was discontinued, and the outer wound was allowed to close. Subsequent examination showed that the healing occurred through the intervention of a pneumothorax, as in the case just related. Having found this last method to be so successful, I have adopted it as the routine method in all empyemata.

There are, therefore, in addition to the "classical" method at least two other methods of healing an empyema. It is on this account that I now find difficulty in exactly defining the word "chronic" as it relates to empyema. In the light of our present knowledge, I would exclude from the chronic group any case of empyema which is amenable to sterilization by means of the Carrel-Dakin treatment.

If the cases of empyema, which cannot be remedied by even long-continued treatment with Dakin's solution are examined, there will always be found a definite underlying cause, the removal or eradication of which,

Fig. 7

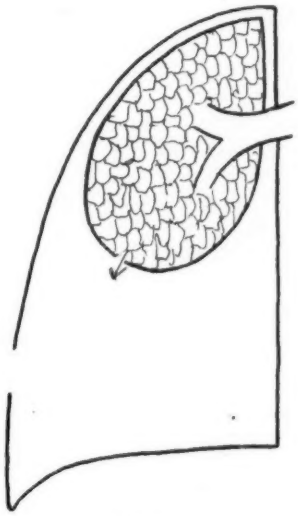

Fig. 8

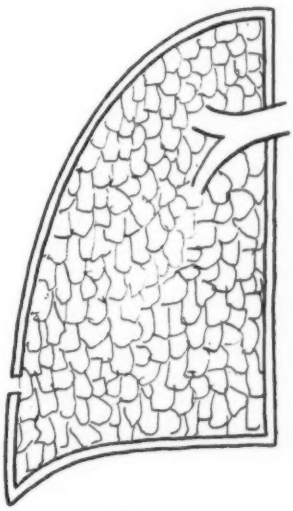

Fig. 9

Fig. 7. An acute hydropneumothorax or pyopneumothorax under extreme tension calling for immediate thoracotomy.

Fig. 8. Pleuropulmonary fistula.

Fig. 9. Bronchocutaneous fistula.

occasionally by a trivial operation, will lead to a successful issue. These reasons are few in number, viz.:

1. Cases in which the drainage opening is not favorably placed.
2. Cases with contracted drainage opening.
3. Cases with necrotic ribs.
4. Cases with retained foreign bodies.
5. Cases with side pockets and lateral branch sinuses.
6. Pulmonary fistulæ.

The indications for the treatment in the first four conditions mentioned above is self-evident. In the treatment of the cases with side pockets and lateral branch sinuses an accurate diagnosis of their location and extent is of prime importance. This can be readily done with the X-ray after injecting an opaque substance. Such side pockets should be opened (usually by costatectomy) and treated independently of the main cavity. When this is impossible their exposure through a large intercostal incision by way of the main cavity is indicated.

The treatment of pulmonary fistulæ is somewhat more complicated and on that account deserving of detailed discussion. The etiology of these fistulæ has already been discussed in detail in the chapter on pathogenesis. When the abscess causing the empyema is small, and the opening into the bronchus also small, the perforation usually closes early, so that the injection of Dakin's solution may be carried out without causing diagreeable by-effects.

If there is a communication of the abscess with a bronchus of larger size, we obtain a not infrequent complication known as "pleuropulmonary" fistula (Fig. 8). In the presence of this lesion distention of the cavity with large quantities of Dakin's solution causes a very distressing cough and choking sensation. However, they tolerate the instillation of smaller amounts with perfect comfort; more particularly if attention is paid to the posture of the patient while the fluid is instilled. A position will nearly always be found in which the instillations do not cause distress.

In rare instances the fistula is of unusual size, varying in diameter from that of a pencil to a little finger.

Finally it may happen in some cases of empyema, particularly those that have drained for a long time, that the lung has

expanded until it fills the entire pleural cavity. In such instances the opening into the lung may become adherent to the drainage opening. There is thus formed a short channel, leading directly from the skin into a bronchus. On coughing, air and a slight amount of bronchial secretion is expressed. A sinus of this description should be called a "bronchocutaneous fistula (Fig. 9). They are exceedingly difficult, if not impossible, to cure without operation, because the bronchial and cutaneous epithelium become continuous and form a so-called "lip fistula."

In rare instances I have succeeded in curing such a fistula by a thorough cauterization of the tract with a fine Paquelin cautery; more often this procedure is not successful. Formerly I practiced extensive operations upon these cases, the operation consisting in an extensive thoracoplasty followed by the excision and suture of the sinus. I believe, however, that in most instances this is not necessary. Satisfactory results are obtained by mobilizing the lung and excising the sinus, thereby converting the bronchocutaneous fistula into a pleuropulmonary fistula. The subsequent healing is not as a rule protracted. An inversion suture of the fistulous opening in the lung may shorten the period of healing.

RECURRENCES

The question of recurrences is intimately connected with that of chronic empyema; in fact chronic empyema may well be defined as one which has a tendency to recur.

If we analyze the physical forces which enter into the healing of an empyema, we will find that they are composed of a number of factors, all of which tend to diminish the thoracic cavity. They are, first, the diaphragm ascends; second, the direction of the ribs becomes more vertical; third, the intercostal spaces become narrower, and fourth, the arc of the ribs approaches closer to the median line. At the same time the lung expands until the parietal and visceral pleura become adherent. It is only when this stage has been reached that we can speak with any degree of certainty about a cure; whenever a space is left there is always the possibility of a recurrence. Broadly speaking, therefore, these reaccumulations are always a reflection upon the treatment, for they usually mean that drainage and antiseptic treatment of the cavity have been discontinued prematurely. I have found that this contingency is particularly liable to occur if the external incision is closed operatively, because it not infrequently happens that good judgment is supplanted by haste Even the strictest precautions such as smears and bacteriological cultures, do not always furnish a reliable guide to the presence or absence of micro-organisms. It again only proves the value of the well recognized axiom in medicine, that a negative proof is no proof. An excellent résumé of the recurrences after empyema has been compiled by Franklin A. Stevens (5). Stevens shows that recurrences are less frequent after the Carrel-Dakin treatment, as proved by the following figures: (1) Healed without Carrel-Dakin treatment, 56 cases, recurrences in 10 cases, or 18 per cent; (2) healed with Carrel-Dakin treatment, 63 cases, recurrences in 3 cases, or 4.7 per cent.

The diagnosis of recurrent empyemata is difficult if the signs and symptoms are not marked. Examinations with the X-ray, especially stereoscopically, are of prime help.

The treatment of recurrent empyema differs in no way from that of ordinary empyema. Owing to the narrowing of the intercostal spaces it is usually preferable to resect a rib.

CHRONIC EMPYEMA SINUS

It has been customary to make a very definite distinction between these and the previously discussed cases of chronic empyema. There is in reality no difference; it is merely a question of degree. Cases of chronic empyema exist, in which there is a large cavity and a short sinus; others have a long sinus and a small cavity. Special operative procedures in large numbers have been described, most of which, to my mind, without any particular justification. I believe what I have said of the treatment of chronic empyema in general, applies to that of the chronic sinuses as well.

MAJOR THORACOPLASTIC OPERATIONS

In spite of the best of care some cases of empyema will not heal. I have no hesitancy

in stating, however, that if the treatment of the acute and chronic stage is carried out along the lines laid down in previous portions of my paper, their number will be infinitesimal as compared to former times. It is in these cases, and in these cases only, that recourse must be had to one of the major operations, so called.

The major operations (and I use the word "major" deliberately, because not one of the originators of the method will own up to the real "major" character of his operation) can be divided into two main groups:

1. Those which aim to obliterate the empyema cavity by collapsing the chest wall (Estlander, Schede, Quénu, Beck).

2. Those which aim at a re-expansion of the lung by freeing it from the heavy fibrous deposit which binds the lung down (Delorme, Fowler, Ransohoff, Lilienthal).

It is exceedingly difficult to make a positive indication as to the choice between these operations. They all have a very definite mortality. The lowest mortality is in the Estlander operation (about 15 per cent), but the real indications for this operation are exceedingly limited. The Schede operation has a much higher primary mortality (about 25 per cent). The definite cures in all vary between 50 and 60 per cent.

During my military service, before I found that I could heal chronic empyema by simpler methods, I performed a number of Schede, Estlander and Delorme operations. All of my patients were in such excellent physical condition, through their preliminary treatment and sterilization, that I did not have a single fatal issue. In passing I may mention, that I have found the decortication operation particularly difficult in the empyemata caused by the hæmolytic streptococcus. Of late again, more frequent recourse is had to the decortication operation in the army, and I am given to understand with very gratifying results.

CONCLUSIONS

1. Empyema in most instances results from the rupture of a small subpleural pulmonary abscess.

2. An empyema is the final stage of a process, in which the first stage is a serous pleurisy, and the second a seropurulent pleurisy. The latter is the so-called "formative" stage of an empyema.

3. The "formative" stage of an empyema is unaccompanied by recent pleural adhesions. The stage of "acute" empyema is always accompanied by adhesions.

4. The vast majority of empyema is of the encapsulated variety. Very few occupy the entire pleural space.

5. The treatment of empyema should be begun in the formative stage before the exudate has been converted into frank pus.

6. It is unwise to perform an operation in the formative stage. The mortality is terrific, because the accompanying pneumonia is still in full bloom, and furthermore, because of the absence of adhesions there occurs an acute pneumothorax with "fluttering of the mediastinum," and consequent embarrassment of the action of the heart.

7. The best surgical procedure in the formative stage is repeated aspirations, done as often as is indicated, in order to relieve the embarrassment due to mechanical pressure of the rapidly accumulating fluid. In a few cases this measure is even curative.

8. Feeding with a diet rich in calories is an important adjuvant in the treatment of the formative stage.

9. The treatment in the acute stage of empyema consists in simple intercostal thoracotomy. This operation need not be considered an urgent one, and should be performed when the patient's condition is otherwise perfectly satisfactory. This is the so-called "late" operation.

10. Urgent thoracotomy is indicated only in acute pyo-pneumothorax.

11. The Carrel-Dakin treatment has proved of superlative value in the postoperative treatment of empyema, and should be instituted in every case. There are no contraindications to its use.

12. The mortality of acute empyema by these methods is lower than that reported by other methods of treatment.

13. Empyema cavities heal by three methods:
    a. By the formation and absorption of a sterile exudate.

b. By the formation and "absorption" of a closed pneumothorax.
c. By the "classical" method, i.e., expansion of the lung and obliteration of the pleural cavity.

14. Chronic empyema should not occur, or should at least become very rare, if the methods of treatment of acute empyema, as formulated above are practiced.

15. "Chronic" cases may, therefore, be defined as empyemata which are not amenable to treatment with Carrel-Dakin.

16. Recurrences in empyema are usually the result of undue haste in closing the thoracotomy opening. The percentage of recurrences is less after the Carrel-Dakin method of treatment than after any other.

17. The vast majority of operations that have been devised for chronic empyema will have a very limited field of usefulness, if the methods of treatment advocated above are carried out.

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THE PHYSICIAN AND SURGEON IN THE INDUSTRIAL ERA[1]

By OTTO P. GEIER, M.D., Cincinnati, Ohio

IN the great chaos of world thought today two outstanding problems present themselves for solution: (1) How may international peace be brought about? (2) How may industrial or national peace be brought about?

I hold that these two questions are inseparable. Permanent international peace will never exist until there be peace and unity among the people that go to make up each nation. The master minds of the world are at work on the first problem.

The second problem, touching upon industrial peace—the success, health, unity, and contentment of the people of the nation, is the one that concerns us tonight. It is individual—it is directly and universally personal. No one of us can escape the responsibility of finding answer to the question that bears on the success, health, and peace that shall come to each individual, the sum total of which is finally forged into a national life. How this may be brought about; how these individuals may be drawn nearer to an established order of peace and harmony; how they may be influenced toward maximum production for their own success and for the community welfare; how they may be brought to their best citizenship, actively in support of their own government; and finally, how that government may come to be but the composite expression of the best desires and ambitions of men, is the special challenge that comes to the medical profession.

It has been indelibly impressed on us these past few years that if the majority of the persons that make up a nation are badly dealt with; if they believe injustice prevails, if they feel that their living and working conditions are unfair, then a state of unrest and publicly expressed dissatisfaction will result, production is interfered with, suffering and want ensue, government then becomes unstable, and crime of every known variety becomes rampant. These things are destructive to citizenship—they are a blight on national life.

Our subject, "The Physician and Surgeon in the Industrial Era," is most timely. This is not only the industrial era, but also the era of greatest industrial strife. Public disorder and strife originate almost wholly in the clash of opinion between organized money and organized labor. Strikes and lock-outs, with their attendant turmoil, are but outward signs of a constant warfare that is going on between these groups. Thus we are uncomfortably reminded daily that ours is the in-

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dustrial era; that the individualistic viewpoint no longer holds; that we must adjust our work and our thinking to large groups and great units of society; that we must think in terms of the mass rather than of the individual; that this is the day of group action; that this is the day for mass treatment.

Recall, if you will, the national peril of business stagnation and starvation that England has just faced; recall also the similar situation in our own country three years ago when the railroad brotherhoods forced the nation to its knees in the passage of the Adamson law. Its recent arrogant progeny is the Plumb bill. We have but just passed the crisis of the steel strike, only to be threatened by a coal famine, with its almost limitless possibilities for nation-wide disaster. Here the ultimatum of organized labor is for a six-hour day, a five-day week, and 60 per cent increased pay. This is but another example of the vicious, ever-widening circle of higher costs with lowered production; yes, actual shortage of an industrial and domestic necessity.

This type of demand by labor, coupled with successful propaganda by the I. W. W.'s, the bolsheviki, and the radical socialists, strikes terror to all serious thinking men. Russia exemplifies what happens to industry and production when rampant radicalism overwhelms a country. Industrial stagnation —insufficient production—hunger, means a revolution. All men and groups of men of any moral or mental status or leadership must definitely assign themselves to the task of stilling the present unrest. Selfish interest and self welfare demand it. The wave of temporary patriotism is over. The patient understanding and daily patriotism must prevail for the future years. No class is more challenged by these facts than is the outstanding group of physicians and surgeons.

What part is our profession playing in this post-war psychology—this industrial and social crisis? Are we making our contribution to the study of the problems of industry and labor? Have we adjusted the science of medicine to the needs of these two groups, or have we practiced our profession with individuals just as we might have done one hundred years ago? Have we not failed to develop a consciousness of group problems?

Bear with me in asking these personal questions. Is it not paradoxical that the physician, who to his patient appears as the most socially-minded individual, should prove so unsocial and so inactive in his public thinking? Is it not strange that we who have the closest view of the intimate living and thinking of the people, should play so small a part in the disposition of their individual or group lives? Dare we any longer stand aloof and fail to make ourselves felt in the great social and economic changes that are taking place? Is it not equally strange that we should retain such a narrow perspective of the capacity of the profession to assist in these national problems? Health and sanity —these are basic of all these considerations. Are we doing all we can to bring them about? This would seem to be our especial function in society. And yet the most far-reaching social measures which have to do with care and cure of disease and accident have been, and are being framed into legislation without taking us into account.

As an illustration, were our surgeons carefully consulted when Workmen's Compensation Acts, for the care of industrial accidents, were established? Are we satisfied with the application of this law? Isn't it a fact that, generally speaking, medical men, not qualified surgeons, are tinkering with the industrially injured? For the worker, this means prolongation of the case, greater loss of wage, unnecessary invalidity, with practically no scientific rehabilitation; for the employer, it means the idle machine, lowered production, with higher cost; for society, it inevitably means definitely lowered standards of living and higher costs of living.

On the other hand, was the profession entitled to much consideration? Is it not a fact that for years we blindly went on repairing the hundreds of thousands annually injured and maimed, without public protest and without suggesting an improved program? It occurred to labor to seek compensation for lost time from accidents, and payment by the state of the surgeon's fees. In the very nature of the case, labor could have

no knowledge as to how to obtain the best surgical results for the injured, yet they dictated the law. Moreover, it remained for industry, not the profession, to set under way that wonderful safety first movement, which has reduced death and accidents by approximately 50 per cent. Is the obligation not upon us now to propose the proper type of surgical organization under Workmen's Compensation Acts that shall place all of the surgery rendered the injured workmen under the supervision of the best trained men in the profession, who, with a corps of assistants, and with the states divided into districts for such supervision, will see to it that justice is done both the injured worker and the profession?

Are we not assuming the same negative attitude toward the movement for the better organized application of group curative medicine? Are not the physicians practically being ignored by the framers of Compulsory Sickness Insurance, another group program? And yet we shall all admit that the future of the scientific teaching of medicine, as well as its economic practice or application, will be absolutely determined by the enactment of such a law. Unless the profession comes out of its social, or rather unsocial torpor, we may be sure that such legislation will be made to fit the whims of the perniciously active reformer, whether or no it pleases us or benefits labor or capital. Here again we have permitted industry, unaided, to visualize, ahead of us, the necessity of a constructive, preventive health program, as an integral part of any intelligent legislation for Health Insurance. Does this recital of our social inactivities possibly suggest why we have been so unsuccessful in our demands for a Federal Department of Health?

How can we understand and contribute to economic and social legislation unless we get a near view of the problems of labor and industry? Can we do this best merely by prolonging our scientific discussions in sequestered places, or by also entering into the life and understanding of industry, learning there to apply our science intensively for the early recognition of disease and its prompt cure? It is here through supervision of the group that education of the adult for the prevention of disease and accident may be best applied. Energy applied to the group always means a maximum result with a minimum effort. On the other hand, can we hope to mold the attitude of organized labor toward health programs unless we offer a solution to the back-breaking load that preventable disease and suffering is causing the worker? Are we strong enough to overcome its objection to physical examination and medical supervision of the worker as a national economic asset?

We must recognize that almost all old standards of thinking are in the discard. We are passing through a period of unstable thought. The pendulum has swung far and wide. The autocratic employer of yesterday is more than matched by the autocratic employee of today. Our profession, along with a great mass of people, is in the arc of the swing, and must needs be on its guard.

If the world is to progress, the medical profession must render its best service, indispensable to the main groups of society. Are we perhaps not the very latent force that if properly applied, will do much to establish better relations between labor and capital, a new confidence between these warring factions, a better understanding on the part of each of the difficulties and purposes of the other. We can help close the gap—narrow the gulf—by humanizing industry. This approachment will come not by the fact that the physicians will act as mediators in any active struggle, but by daily furnishing human contacts on which better understanding and greater tolerance are created. In actual industrial practice the physician acts as the liaison force between employer and employee.

If such premise be sound, if any such hope of new human service exist, it behooves us as a profession to take inventory and better fit ourselves for this national reconstruction. We have still to demonstrate our worth. Our usefulness in public discussion of serious labor problems is not noteworthy.

Did it strike any of you as curious that the President did not include a member of our profession in his National Industrial Conference at Washington, which began on October 6?

Organized labor is given 13 representatives with four additional from the railroad brotherhoods, making 17 in all; the United States Chamber of Commerce, and the National Industrial Conference Board are each given 5 representatives; while the farmers' organization and the bankers' association are allowed 3 and 2 members respectively. One would gather from the above that the organized portions of society have their interests fairly well protected in this conference. Can we say as much for the public, which all too frequently finds itself squeezed by the pressure which any two contending forces happen to exert on each other?

It is interesting, therefore, to note which of the fifty-seven varieties of statesmen who have been appointed to the National Industrial Conference, are represented in the twenty-five individuals chosen to appear in behalf of the public. Unofficial record and *Who's Who in America* reveal the fact that the public is here represented by one broker; two bankers; two socialists, one a writer and the other, once an aspirant for public office in New York; one president of a farm bureau federation; a cotton manufacturer; a clothing manufacturer; three directors of large corporations; one attorney for railroads; one paper bag manufacturer; one wagon manufacturer; one editor of a farm paper; one designated as a lawyer and politician; another known as "potato king"; one indicated as oil operator and lobbyist; one woman publicist; two women social workers; along with John D. Rockefeller, Jr., Elbert H. Gary, of the steel corporation, and Dr. Charles W. Eliot, president emeritus of Harvard College.

The one issue that is not controversial in this conference is that of decent living and working conditions. Within this issue are bound up problems of shop sanitation, the question of working conditions, prevention of occupational disease and accidents, medical supervision with physical examination, to say nothing of the living conditions—housing and community health programming. These are factors in the industrial relations conference to which the physician, with his scientific training and social viewpoint, might have given invaluable suggestions, and yet we were, of all the professions, distinctly counted out. These are the things that make for the success, health, unity, and contentment of the people and are vital to national and international peace.

If production is the keystone of a world reconstruction, and if health and sanity be so large a factor in production, had we not better move the physician out of his private office and into industry? Here he will soon be less an individualist. He need not be less scientific, but he certainly will be more usefully scientific, as he touches elbows with those who rarely see or know the best that is in medicine or surgery. He will be applying to the great mass of workers—the backbone of the nation—that great storehouse of scientific knowledge and research which today is finding application in only a fractional part of the population.

It has become axiomatic that only the rich and the very poor get the best that we have to give as a profession. This fact becomes startling when viewed from the industrial clinic. Your hospital or medical college clinic only meets a fraction of the problem. You are working there with those who have fallen below the poverty line—too late to do preventive social work, often too late to do preventive medical or surgical work. And what a wondrous waste of energy, for only about 15 per cent of your clinical cases ever return for further observation. The clinic within industry prevents the unfortunate but good American workman from reaching the poverty line—it keeps him out of the charity class.

Within the past decade there has developed as a result of a strong demand on the part of industry, a new specialty to which hundreds of our profession are now devoting themselves. The industrial physician and surgeon is desperately attempting to cope with the manifold economic and social problems that are being brought to his attention. He is making himself familiar with the health problems of industrial institutions and those of the community. He is trying to make himself the master of the medical and surgical problems of industry, which I assure you are quite distinctive from those that the

general practitioner and surgeon meets. He must have knowledge of the sanitary standards of plants, of occupational diseases, the subject of fatigue, the principles of safety work; he must know how to approach the subject of the medical supervision of the employees, with special emphasis on physical examination, the proper placement of the employee, dental hygiene, and nursing service; he must have a real interest in the broad question of personal relations in industry, must understand employment methods, with the proper recording of absence, lateness, illness and injury, labor turn-over, and their bearing upon production; he must know the problem of the health of the employee in relation to the establishment funds, or "mutual aid associations" as well as the other factors of industrial health—recreation, food, cafeterias, rest periods, and so on.

The subject of lost time from work on account of illness, injury and other causes, is being continually related to the man's productivity and earning capacity, and in this way the physician's knowledge of medicine and surgery becomes a factor in economic life. It is the business of the industrial physician and surgeon to discover the existence of unhealthy working and factory conditions, —the matter of inadequate ventilation, lighting, drinking water, toilet and locker facilities. These things, along with the occurrence of dust, fumes, gases, poisons, overcrowding, unnecessary noises, excessive variations in temperature and humidity, some of which produce an impaired vitality and low output, are his daily concern. The subject of fatigue, along with monotony, speed, and overtime, all become the problems of the industrial physician, to be weighed in as factors in inefficiency and low earning capacity. Who can say how far fatigue brings on soreness of mind, and again how far soreness of mind predisposes to bodily fatigue? To what degree is that soreness of mind expressed in unrest?

When this type of work is well done, the physician becomes a social and medical engineer. He makes available to the mass of working men the best surgical and medical skill; he intensively educates the worker to the dollars and cents value of good health and personal hygiene; and finally, and perhaps most important, he gives the employer accurate knowledge of the social, economic and health conditions of the worker, otherwise unobtainable. He affords to the employing class, interest in and greater appreciation of the value of community health, and thus makes for the extension of public health control.

Out of this great human laboratory comes the conviction that the medical profession must square itself with the conditions that obtain in this industrial era. This experience spells a need for group diagnostic clinics, where the average worker may pay a reasonable charge for the best diagnosis. The industrial clinic, acting as a diagnostic clearing station, is continually sending to the physician and surgeon on the outside, cases requiring operative and medical procedure. Too frequently these cases are being charged out of proportion to their capacity to pay.

It may amaze you to know that the average worker receives his first complete physical examination in the industrial clinic. He is too often the victim of blind, gun-shot prescriptions. The industrial clinic is teaching him to seek a better type of physician for himself and his family, and in that sense the industrial physician is tending to raise the standard of private practice on the outside.

In attempting to secure this better medical and surgical attention, the inadequacy of hospital and clinical facilities to care for the man who desires no charity, but who deserves the profession's best service at his price, becomes apparent. Whether the workman can receive his just dues in this regard without the intervention of some system of social insurance, remains for our profession, in conference with political and social economists, to determine. Again we have a group problem calling for mass treatment.

The industrial physician is doing much to mold opinion in behalf of preventive medicine. He is intensively educating the worker to care for his health. Our mortality rates can only be further lowered by such type of work, for the public seems to have reached a saturation point in regard to the educational appeals

sent through the press by health departments. Industry can make use of the economic pressure to secure attendance to health matters.

The industrial physician recognizes not only the particular symptom of the patient in his clinic, but he visualizes through him the shop, the bench, the particular occupation, that is affecting him; the dirt, the danger, the monotony, the home environment of the man before him. His preachments for healthful living are readily translated into the fact that each day of illness means a cramped budget at home; that prolonged absence on account of preventable accident, is, through lowered production, adding to the cost of living.

It must be apparent that service of this type is more than mere medical or surgical service; that it is intensely conservative of the body and mind of the worker; that it humanizes his place of work; that it must change his attitude toward his job and officials in the plant; that it paves the way for clearer thinking and greater self-expression; that it substitutes personality for the mere dull cog in the machine; that it calls out character both in the employer and the employee; that we thus secure an improved mass morality in both groups, and hasten the day of the true spirit of justice and good will in industry, the day of a real democracy between men.

These are some of the problems that the physician and surgeon of the industrial era must meet. These are questions which particularly challenge the attention of this society, which has within its membership men with vision, who see things in a big way, who have shown an ability to do, who have developed a capacity for leadership. Your society has the power to sway medical and public opinion; you have the organization to carry out any plan to reach any goal you set for yourselves. It is for you to evaluate this new specialty—to institute appropriate courses in medical colleges; to further its wider extension in industry. Please remember that unless the task outlined for the industrial physician is accepted by him, there is no one else who can undertake the task.

It is for the medical profession at large to determine what place it will hold: whether in the swift current of thought, or in the quiet eddies; whether to stay on the edge of life, or close up to the great melting pot of human experience; whether to remain as spectators, or join in the struggle of progress; whether to rest in billet, or press on to the firing line, where men are fighting for life's goal.

The responsibility of leading the profession at large can well be left with this society. I refuse to believe that you will not use your tremendous influence in this industrial crisis to set the people thinking sanely; that you will not assist in placing the medical profession back among the people—the doers and the hewers; to reproduce the original place of the physician in society, that of priest, confessor, teacher and healer; that you will not help place our medical, surgical and philosophical service right out among the people—place it at the ignition point of life, where it can be consumed and help fashion into thought and being a national life commensurate with the standards of those who set up our great republic. The obligation is yours; the service asked, ennobling; the opportunity for enlarging life, immeasurable.

OBSERVATIONS IN FIVE HUNDRED CASES OF INJURIES OF THE PERIPHERAL NERVES AT U. S. A. GENERAL HOSPITAL NO. 11 *

By Lieutenant Colonel CHARLES H. FRAZIER, M.C., U.S.A. and First Lieutenant SAMUEL SILBERT, M.C., U.S.A.

Of the 208,000 casualties in the American Expeditionary Force, there were in the general and base hospitals in this country in April, 1919, 3,000 patients with peripheral nerve injuries. Assuming that 15 per cent of the total admissions had been discharged by this time—a conservative estimate—there were altogether approximately 4,500 peripheral nerve injuries or 1.6 per cent of the total casualties.

With but few exceptions, the treatment of peripheral nerve injuries did not begin until the soldiers from overseas became patients on this side of the Atlantic. Obviously this was a problem which belonged to the reconstruction hospitals and not to the hospitals of the war zones. In more than 500 cases admitted to General Hospital No. 11, there were not more than 5 cases in which the nerve had been sutured overseas.

The Surgeon General recognized in the management of peripheral nerve injuries a problem quite distinct from that either of general or orthopedic hospital and authorized the organization of ten peripheral nerve centers, in as many general hospitals, to which all patients were to be transferred from the ports of debarkation or later from base hospitals, to which a number found their way with lesions of the nerves unrecognized at the time of their admission. In each of these peripheral nerve centers an officer, experienced in neurological surgery, was assigned and a consulting neurologist and equipment essential for examination and treatment were provided. As an additional recognition of the importance of the peripheral nerve problem, the Surgeon General approved the organization of a Peripheral Nerve Commission, selected the personnel, and issued instructions as to the scope of its work. Among other things this commission will prepare for the Surgeon General a comprehensive report dealing with the various aspects of peripheral nerve injuries and the results obtained by treatment.

It has been my privilege as consultant in neuro-surgery to the Surgeon General's office, to visit the clinics in many of the peripheral nerve centers, but the views herein expressed will be based more particularly upon the observations of between five and six hundred cases under my direct supervision at General Hospital No. 11 (Table I).

To systematize the preparation of the clinical records, printed forms were prepared, afterward adopted by the commission as the authorized form for all the peripheral nerve centers. A technique of examination was elaborated, special instruments were designed, and instructions were issued as to how the phenomena were to be elicited and recorded. Orders were issued that duplicate copies of all clinical records be furnished to the Surgeon General's office so that the Commission might have, as the basis for its final report to the Surgeon General, complete and uniform records of all peripheral nerve lesions standardized as to methods of examination and record.

SENSORY PHENOMENA

With regard to observations upon disturbances, we disregarded the theory of Head and his well known classification of "epicritic" and "protopathic" sensory loss. The subsequent experiments of Trotter and Davis[1] and later of Boring[2] proved the fallacy of Head's theory and disproved the idea that there are separate fiber systems for moderate (epicritic) and for extreme (protopathic) temperature, tactile, and pain sensibility. Furthermore, the clinical observations from the wealth of material, provided by the four years of war, may be cited in refutation of Head's classification. Lieutenant Cobb, from his review of the literature and from his study of the problems in our clinic, concluded that dissociations of sensation due to peripheral

[1] J. Physiol., 1909, xxxviii, 134.

[2] Quart. J. Exp. Physiol., 1916, x. 1.

* The views expressed in the observations recorded in this article represent those of my associates on the staff as well as my own. I am indebted to the cordial co-operation of Majors Coleman and Selling, Captains Ingham, Kraus, and King. First Lieutenants Arnett, Anderson, Baird, Behnev, Buerki, Cobb, Hobson, Kennedy, McCutcheon and Silbert.

TABLE I. — TABLE SHOWING NERVES INVOLVED IN A SERIES OF 400 CASES

Upper extremity		Percentage
Ulnar	112	22
Musculospiral	96	18.9
Median	88	17.3
Brachial plexus	37	7.2
Musculocutaneous	13	....
Facial	13	....
Internal cutaneous	9	....
Circumflex	5	....
Radial	2	....
Lingual	1	....
Hypoglossal	1	....
Supraspinatus	1	....
Total	378	74.5

Lower Extremity		Percentage
Sciatic	53	10.4
External popliteal	53	10.4
Internal popliteal	11	2.1
Anterior tibial	4	....
Posterior tibial	2	....
Lumbar plexus	3	....
Small sciatic	1	....
Anterior crural	1	....
Musculocutaneous	1	....
Total	129	25.5

nerve lesions arose from comparing stimuli, not only quantitatively different but qualitatively unequivalent. By varying the quantitative values of the stimuli, dissociations of sensations could be produced almost at will. In short they are artefacts due to lack of proper standardization of the examination. Hence, it became apparent that in the examination of disturbed sensation, standardized instruments had to be employed and the examinations conducted under uniform conditions. If the limb was cold at one examination and warm at another, there would be a difference of 0.5 centimeters to 2.0 centimeters in the ulnar and even 5 centimeters in the sciatic distribution.

Upon the adoption of standardized algesimeters and a uniform technique, it was found that in the examination of an individual case by different members of the staff the sensory charts were precisely similar (Fig. 1). The technique included:

a. An examination for tactile sensibility with a camel's hair brush, so pliable that the skin could not be depressed. Loss to tactile sensibility was indicated on the chart by lines representing the stroke of the brush.

b. Test for pain sense with an algesimeter with 15 grams' pressure, indicated when lost by large dots on the sensory chart (see Fig. 2).

c. Test for deep sensibility by an algesimeter with 1000 grams' pressure indicated when lost by small dots or solid black (see Fig. 2).

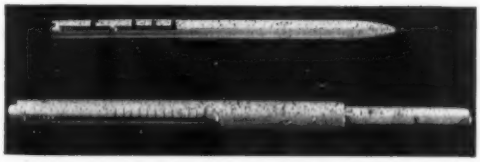


Fig. 1. Æsthesimeters devised at U. S. A. General Hospital No. 11 by Captain Ingham.

ELECTRICAL EXAMINATIONS

Electrical stimulation of muscles or nerves at the evacuation or base hospital is an invaluable aid in distinguishing the organic from the functional paralysis. In the reconstruction hospital where the patients are received 3 to 6 months after the injury, the value of the electrical examination is twofold: (1) to observe evidences of recovery, (2) to determine whether the condition is stationary or retrogressive. In recording the electrical findings, a special chart is used and instructions issued to all peripheral nerve centers as to how the findings are to be recorded (Fig. 3). We eliminated the terms "Reaction of Degeneration" as indicating conclusions rather than observations and instructed the examiner to record precisely what he elicited: (1) whether "faradic" contractions were "normal," "weak" or "absent," and (2) in the galvanic stimulation the rapidity of the contractions and relaxations and the presence or absence of reversals. By this system of record, comparisons could be made between examinations of different dates. The instrument supplied to all peripheral nerve centers was the Wappler galvanic and faradic plate. The investigation and interpretation of the electrical findings at General Hospital No. 11 is under the direction of Lieutenant Silbert, and the following are some of his deductions:

1. The loss of skin sensibility to faradic current is fairly good evidence of complete interruption. Tinel's observation that the return of skin sensibility is the earliest sign of nerve regeneration has been confirmed by the examinations in this clinic.

2. Occasionally the loss of skin sensibility is incomplete in cases proved at operation

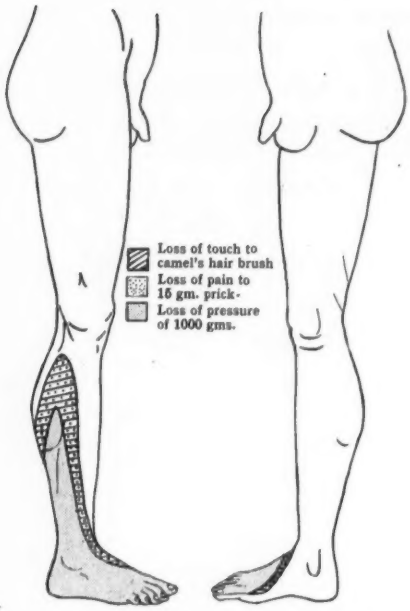
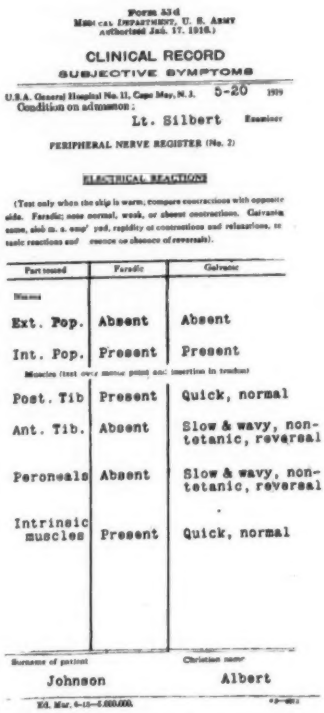


Fig. 2. Chart showing method of recording sensory examination.



Form 53d
MEDICAL DEPARTMENT, U. S. ARMY
Authorized Jan. 17, 1918.)

CLINICAL RECORD
SUBJECTIVE SYMPTOMS

U.S.A. General Hospital No. 11, Cape May, N. J. 5-20 1919
Condition on admission:
Lt. Silbert Examiner

PERIPHERAL NERVE REGISTER (No. 2)

ELECTRICAL REACTIONS

(Test only when the skin is warm; compare contractions with opposite side. Faradic; none normal, weak, or absent contraction. Galvanic same, also m. a. cmp' ysd, rapidity of contractions and relaxations, re tonic reactions and essence or absence of reversals).

Part tested	Faradic	Galvanic
Nerves		
Ext. Pop.	Absent	Absent
Int. Pop.	Present	Present
Muscles (test over motor point and insertion in tendon)		
Post. Tib	Present	Quick, normal
Ant. Tib.	Absent	Slow & wavy, non-tetanic, reversal
Peroneals	Absent	Slow & wavy, non-tetanic, reversal
Intrinsic muscles	Present	Quick, normal

Surname of patient: Johnson
Christian name: Albert

Ed. Mar. 6-13—5,000,000.

Fig. 3. Chart showing method of recording electrical examination.

to be complete interruption. This phenomenon has been attributed to the presence of anastomotic communications between the nerves below the level of the lesion.

3. Faradic response may be lost even in incomplete and mild lesions, and such as those of moderate contusion, and is, therefore, of little value in a decision for or against operation. With but one exception in the operative series and in but three of all other cases did voluntary motion not return before that of response to the faradic current.

4. Stimulation by galvanism applied over the course of the damaged nerve uniformly fails to give a response in the muscles below the level of the injury.

5. The following deductions are drawn from the application of galvanism to the muscles supplied by the damaged nerve:

a. The maximum response is usually over

TABLE II. — SUMMARY OF ELECTRICAL EXAMINATIONS IN 100 CASES OPERATED UPON

	Faradic						Galvanic											
	Area of loss of skin sensibility			Muscle response			Nerve response			Muscle response								
										Slow			Tetanic			Reversal		
	Present	Absent	Not recorded	Present	Absent	Not recorded	Present	Absent	Not recorded	Present	Absent	Not recorded	Present	Absent	Not recorded	Present	Absent	Not recorded
Compression	1	3	6	0	10	0	0	10	0	9	0	1	1	5	4	1	4	5
Neuroma	20	17	15	0	52	0	0	50	0	50	0	2	6	30	16	11	38	3
Interruption	13	8	17	0	36	2	0	36	2	36	0	2	1	27	10	20	15	3

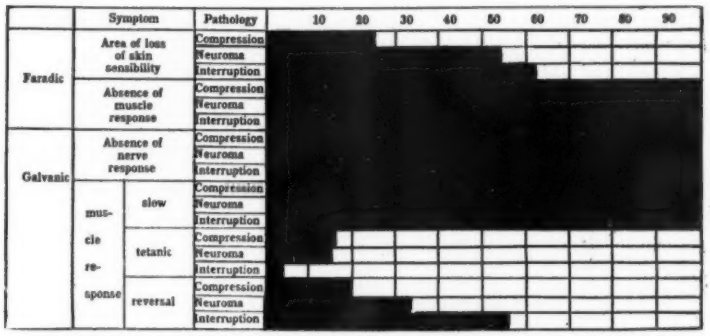


Table III. Summary of electrical examinations in 100 cases operated upon.

the tendon of the muscle or at the junction of tendon to muscle belly and not as in the normal muscle at the motor point.

b. The rapidity of contraction is the best guide to the degree of degeneration; the slower the reaction the more complete the degeneration.

c. Tetanic response is observed occasionally but its significance is not clear.

d. The reversal of polarity is the most valuable of all phenomena. Though not invariably yet in the majority of cases reversal signifies anatomical interruption.

e. Reversal of polarity is occasionally seen in normal muscles (see Tables II and III).

TROPHIC AND VASOMOTOR DISTURBANCES

Trophic and vasomotor disturbances of peripheral nerve lesions, are frequently observed but are of comparatively little practical importance, as affecting diagnosis, prognosis, or treatment. Capsular and muscle fibrosis are the most serious complications of peripheral nerve lesions and they are introduced in this connection because so often vaguely attributed to trophic influences. This disability arising from these two factors is extreme and unless relieved the regeneration of the injured nerve will avail but little. For reasons not clear the metacarpophalangeal joints are the most seriously involved. The cause of these crippling lesions in muscle and joint has been the object of an investigation in our clinic by Major Selling, and he has come to these conclusions: (1) In uncomplicated lesions there is no limitation of passive motion, except that which results from shortening of the paralyzed muscle, when the limb is properly splinted. This is of minor importance as the disability is soon overcome after the muscles have regained their function. (2) When nerve injury is complicated by fracture, prolonged immobilization and particularly by suppuration in the healing process, the result is often capsular fibrosis no matter what the nerve involved, whether musculospiral, ulnar or median. (3) If, however, there is a serious vascular lesion of the main arterial trunks, added to the capsular fibrosis, there is extensive muscle fibrosis and the combination of these is responsible for the extreme limitation of motion. The fact that in median and ulnar lesions of the arm, there is greater likelihood of involvement of the main arterial trunks accounts for the fact that these crippling deformities are seen more often in median and ulnar than in musculospiral lesions; and the same line of reasoning may be applied to

TABLE IV.—FACTORS INVOLVED IN LIMITATION OF MOVEMENT

1. Direct damage—joint and muscle.
2. Fibrosis and shortening paralyzed muscle.
3. Adaptive shortening normal muscle.
4. Capsular fibrosis.
5. General muscle fibrosis.

Nerve lesion.	*Limitation Joint Movement.*
1. Uncomplicated	a. absent b. due to shortening of paralyzed muscles
2. Complicated by a. fracture b. immobilization	Capsular fibrosis
c. suppuration	Other factors secondary
3. Complicated by vascular lesion	Capsular fibrosis Extensive muscle fibrosis and shortening.

TABLE V.—FACTORS IN JOINT LIMITATIONS IN A SERIES REPRESENTING THE MUSCULOSPIRAL, MEDIAN, AND ULNAR

Name	Lesion	Location	Fracture	Suppuration	Immobilization	Vascular	Elbow	Wrist		Fingers Limited Movt. Due to	
								Flex.	Ext.		
W. C.	M. S.	Arm	0	0	0+	0	0	+++	0	0	Wrist flexion; shortening of extensors.
W. C.	Med.	Axilla	0	0	0	0	++	0	++	0	Elbow direct injury. Wrist ext.; shortening of flexors.
P. H.	U.	Arm	0	0	0	0	0	0	+	0	Wrist ext.; shortening of flexors.
H. D.	M. S.	Arm	Humerus	+++	+++	0	+++	+++	++	++	Joint involvement (capsular fibrosis) all joints.
E. E.	Med.	Arm	Elbow	+++	+++	0	++++	+++	+++	+++	Joint involvement all joints. Elbow direct injury; others capsular fibrosis.
B. H.	Ulnar	Arm	Elbow	+++	+++	0	++++	+++	+++	++	Joint involvement all joints. Elbow direct injury; others capsular fibrosis.
H. H.	Med. Ulnar	Arm	0	+	++	Oblit. Brachial Artery	+++	+++	+++	+++	Joint involvement all joints Capsular fibrosis and extensive muscle fibrosis.

the lower extremity, where the most commonly affected nerve, the sciatic, is not accompanied with an injury of the large vascular trunks (see Tables IV and V).

PATHOLOGICAL CONSIDERATIONS

The pathology of peripheral nerve lesions was not overlooked in the turmoil of war, and of the noteworthy investigations mention should be made particularly of those of Cone and those of Huber, to whose direction the Surgeon General assigned the experimental study of nerve regeneration, as applied to nerve suture, and the minute examination of the pathological material removed at operation in the several peripheral nerve centers. The various types of lesions have been classified under five headings.

1. Complete anatomical interruption
   a. with central bulb,
   b. with central and peripheral bulb;
2. Neuroma in continuity
   a. central bulb;
   b. lateral bulb;
3. Partial anatomical interruption (lateral notch);
4. Sclerosis;
5. Compression
   a. by callus, bone spiculi,
   b. by aneurism,
   c. by scar tissue.

The pathological investigations in our clinic have been made, apart from the routine examination of specimens, chiefly along two lines; the topographical study of specimens removed with relation to the results of electrical stimulation on the operating table, and the distribution of motor and sensory disturbances and the correlation of pathological and electrical findings.

With regard to the latter, the complete and incomplete sensory, motor, and electrical findings have been tabulated in Table VI with relation to the three essential lesions: compression, neuroma in continuity and complete anatomical interruption. It is of interest to note that in the majority of instances a careful examination of motor, sensory, and electrical disturbances foretold the character of the lesion found on the operating table. Thus (1) in compression there was complete motor paralysis in 45 per cent, complete sensory loss in 15 per cent, and no case with complete reactions of degeneration. (2) In complete anatomical interruption there was complete motor loss in 100 per cent, complete sensory loss in 86 per cent and complete reactions of degeneration in 85 per cent. (The absence of complete sensory loss or reaction of degeneration in the minority may be attributable to the fact that in the scar tissue intervening between the divided seg-

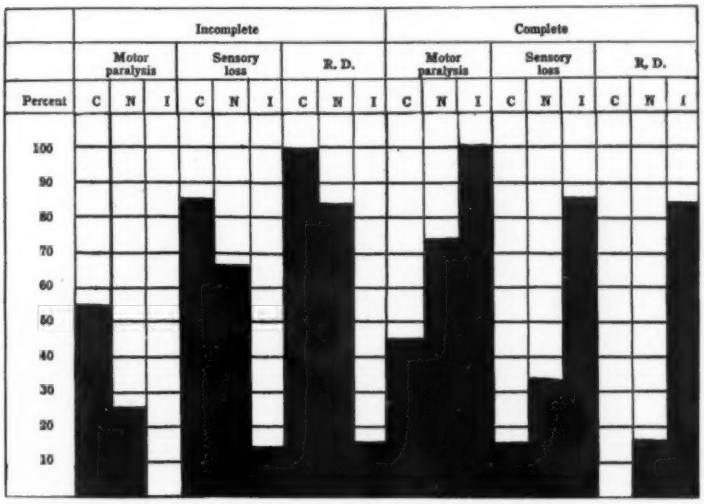


Table VI. Showing percentage of incomplete and complete motor, sensory, and electrical syndromes in compression, *C*, neuroma in continuity, *N*, and anatomical interruption, *I*.

ments a few indistinguishable fibers may have been present.) (3) The neuroma in continuity presented a picture, as one might expect, intermediate between compression and complete interruption. Thus there was complete motor loss in only 74 per cent, incomplete in 26 per cent; complete sensory loss in only 33 per cent, incomplete in 67 per cent; complete reaction of degeneration in 16.5 per cent, incomplete in 83.5 per cent.

TIME OF OPERATION

The determination when to operate is a matter of vital importance. Without fear of contradiction it can be assumed that the sooner the operation the better, but from indiscriminate, hasty resort to operation one must refrain for two reasons: (1) because many cases will recover spontaneously; (2) because the presence of an infected wound necessitates postponement. Looking at the statistics in our own clinic, we find that the first signs of recovery were not observed in a number of cases until 8 months after the injury (see Table VII). Of the recovering cases, 36 showed the first signs of recovery in the fifth and sixth month, and 26 in the seventh and eighth month. From these figures and those in the table it would be evidently unjustifiable to resort to operation, at least until six months had elapsed, and there might in view of these figures be some justification for waiting a month or two longer. The percentage of spontaneous recoveries may vary in different clinics. At General Hospital No. 11, taking the last 400 cases, 254 or 63 per cent had recovered sufficiently to be discharged or were in the recovery stage, 112 or 28 per cent had been operated upon and 9 per cent were stationary and unimproved (Table VIII).

TABLE VII.—SHOWING THE FIRST RECORDED SIGNS OF RECOVERY IN A SERIES OF 400 CASES

	Cases	Percentage
2 months	13	3
3 months	34	8.5
4 months	71	17.7
5 months	77	19.4
6 months	67	16.8
7 months	61	15.3
8 months	45	11.3
Over 8 months	32	8
	400	

Viewed from the standpoint of the condition of the wound, the advisability of waiting until the wound has been healed 3 months has been recognized as a wise precautionary

TABLE VIII.—SHOWING THE DISPOSITION OF A SERIES OF 400 CASES

Cases discharged—		
Operated upon	3	
Not operated upon	125	128
Cases remaining—		
Operated upon	109	...
Not operated upon	...	...
Improving	129	...
Stationary	34	272
Total		400

TABLE IX

Time it took wound to heal in a series of 400 cases	Cases	Time of operation if performed 3 months after wound healed	Percentage
1 month or less	126	4 months	31.5
2 months	90	5 months	22.5
3 months	74	6 months	18.5
4 months	36	7 months	9
5 months	26	8 months	6.5
6 months	17	9 months	4.3
7 months	6	10 months	1.5
8 months	6	11 months	1.5
9 months or over	19	12 months	4.7
Total	400		100.00

measure. This has been our practice, and the fact that there have been but three infections in over 100 elaborate, extensive and prolonged dissections, often through poorly nourished tissue and extensive cicatrization, would appear to justify the adoption of the three month rule. Two of these wound infections were superficial and could not have affected the process of regeneration at the line of suture; in one instance recovery has been complete. Applying the three month rule to our own cases (see Table IX) the time of operation would have been deferred to the end of the fourth month in 33 per cent of cases, to the end of the fifth and sixth month in 44 per cent, and to the end of the seventh and eighth month in 15 per cent. Apart from the interpretation of clinical phenomena as indicative of a complete physiological block, these two factors, the chance of spontaneous recovery and the three month rule, are often the decisive factor in determining how soon the patient should be operated upon.

METHODS OF PROCEDURE

Splinting. In the organization of a peripheral nerve clinic, provision must be made for the care of those cases in which spontaneous recovery has already begun as well as for those in which the necessity for operation is still under consideration. The importance of keeping the muscle in a state of rest was recognized long before the war and in lesions other than peripheral nerve palsies. It had been observed in the paralysis of anterior poliomyelitis that when muscles were kept at rest by proper apparatus, recovery of function was more prompt in the first place and in the end more complete. This general principle was recognized in the case of the peripheral nerve palsies, but there is a threefold purpose in the employment of splints. Not only is the muscle maintained in a state of rest, but overstretching of muscle and tendon is prevented and what is of equal importance, contraction and shortening of the antagonistic muscle is impossible.

In our clinic many of the splints employed were designed by Lieutenant Buerki, others were adopted from those in use in other clinics. The splints for musculospiral and external popliteal paralysis and for cases recovering from operation upon the sciatic or popliteal nerves were made after Lieutenant Buerki's designs (see Figs. 4 to 9). The splint for the median and ulnar paralysis was fashioned after the pattern of that used at the Walter Reed General Hospital and that for the brachial plexus palsies after the splint used at General Hospital No. 9. The essential features of a serviceable splint are these: it should be comfortable, light in weight, not cumbersome, of simple construction, easily removed and retained in position without bandages. All the splints in our clinic met these qualifications and were made in the splint room, by unskilled hands, out of heavy steel or copper wire. Especial emphasis is laid upon the avoidance of the bandage in the application of the splint because splints must be removed daily when the patient receives massage or while he is employed in the curative workshop.

Physiotherapy. In all peripheral nerve clinics the physiotherapy department is regarded as an essential feature of the organization and serves a useful purpose. While neither massage nor electricity can in the smallest degree prevent the atrophy of a muscle once its nerve supply has been interrupted, manipulation by massage and passive motion will aid in mobilizing joints that are restricted in movement for one cause or

Fig. 4.

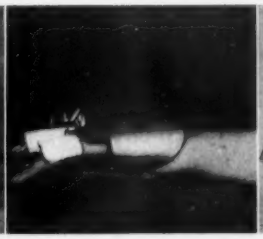


Fig. 5.

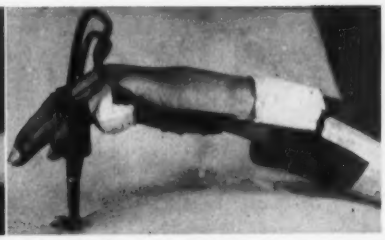


Fig. 6.

Fig. 4. Splint for musculospiral paralysis.
Fig. 5. Splint for ulnar paralysis.
Fig. 6. Splint for median paralysis.

another. Contraction of the paralyzed muscles by electrical stimulation is a valuable substitute for massage, and especially in the operative cases, it is of untold value from a psychological point of view, in that during the long and trying period, both before and after operation, the patient is content in the belief that by some magic influences electricity will restore power to the palsied limb.

For the recovering cases the curative workshop plays an important rôle. There is no doubt that purposeful movements are more effective in the restoration of function than calisthenics, passive movements, or massage. Furthermore the patient himself is much more content, his morale better, when his time is occupied in some form of occupation which maintains his interest.

Secondary débridement. In many instances it was necessary to postpone operation because of unhealed wounds. In many of these there was a chronic osteomyelitis. The postponement of nerve suture for weeks or months was, together with prolonged suppuration, prejudicial to the ultimate recovery of function. To hasten the healing of the wound, Captain King proposed a preliminary débridement with disinfection of the wound by the Carrel-Dakin technique, and when the wound was sterile, secondary closure, filling the defect if any, with a fat transplant. This plan of procedure was put in effect with the happiest result and final healing was secured in three or four weeks in wounds which, if left to the natural processes of repair, would have continued unhealed for as many months (Figs. 10 and 11).

In a paper which touches upon the problems of peripheral nerve lesions from so many angles, it will be impossible to include in the discussion of the technique the many details as they affect the individual nerves. The various steps of the operation will be reviewed as in its wider application and as practiced at General Hospital No. 11. To begin with the incision must extend well above and below the lesion. In the arm it is frequently necessary to make an incision from the axillary fold to the elbow or below, if the ulnar is to be transposed. The nerves must first be exposed and identified well above and below the lesion and then traced as far as possible through the entangling scar tissue. Frequently it is necessary to mobilize the nerve for a considerable distance above and below the lesion to secure approximation after resection.

Instead of towels as wound protectors, we have used a sterile sleeve slit the length of the wound and secured over the edges of the wound with Backus forceps. This enables the position of the arm to be changed, as is so often necessary, with greater facility than if draped with towels.

The dissection itself is one of the most tedious of surgical procedures. An abundance of scalpels is necessary since the edge is soon blunted by the dense connective tissue. While sharp dissection with the scalpel is to be preferred in general, we have found a small pair of eye tenotomy scissors convenient in freeing the nerve at the point it enters the dense scar tissue where it is difficult to distinguish between the two (Fig. 12). There are many objections to the use of the tourniquet and to avoid the necessity of constant sponging in order to keep the field clear, since oozing is

Fig. 7. Splint for deltoid paralysis.

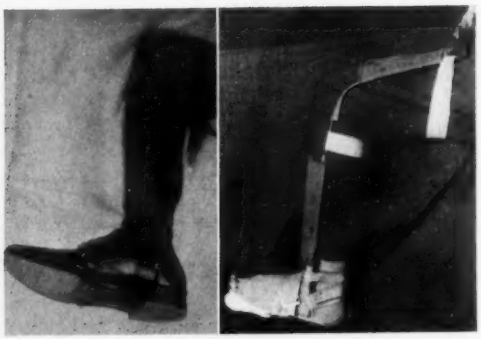


Fig. 8 (at left). Splint for external popliteal paralysis.
Fig. 9. Splint for sciatic paralysis.

continuous, we have found a continuous stream of normal saline solution, directed precisely at the point of dissection to possess many advantages. The constant oozing is an annoying feature, constant sponging traumatizes the tissues and the continuous play of solution upon it keeps the field clear. When sponging is necessary, small pledgets of cotton should be used.

Electrical stimulation. Electrical stimulation of nerves on the operating table may serve a twofold purpose. Occasionally the identification of individual nerves in the upper arm or of roots or cords of the brachial plexus is facilitated by the use of the battery. But more frequently we have found it of service in deciding whether resection is or is not appropriate and how much if any of a given nerve may be conserved. Occasionally the external appearance of the nerve might not justify resection; if faradization of the nerve is followed by a response, resection would be clearly contra-indicated. If doubt still exists as to the propriety of resection we have in some instances split the sheath of the nerve and applied the electrode directly to the fasciculi. By this procedure we have been able to conserve some fibers which otherwise would have been sacrificed. Apart from the practical value of faradization we have been able to make, under the direction of Captain Kraus, interesting observations as to nerve topography. For example, we have found which portions of the circumference of the median nerve are purely sensory and might be sacrificed where it is desirable to use the median as a receptor for lateral implantation suture, as of the ulnar or musculospiral nerves.

Further interesting observations have been made as to the results of nerve stimulation of the peripheral segment after the nerve has been divided preliminary to suture. In one instance the musculospiral, clinically quite unreactive to the faradic and showing a partial reaction of degeneration (no reaction of the nerve to galvanism and slow contraction of the muscles without any polar reversal) gave, on stimulation of the distal end at operation, a definite response in the extensor indicis. In another instance the median nerve was found divided, but stimulation of the peripheral stump gave reactions in the flexors of the fingers and in the pronator radii teres. We shall need pathological confirmation of the absence of connecting fibers in the surrounding tissues. Another type of electrical response has been the presence of faradic reaction at operation but not clinically, with no visible discontinuity of the nerve present. A much stronger current is needed to bring about these reactions in diseased nerves than is needed to stimulate a normal nerve.

Resection. In the final analysis the success or failure of nerve suture depends upon

whether or not both central and peripheral segments contain healthy fasciculi free from the entanglements of adventitious connective tissue. The regeneration processes of nature are so well performed that given healthy fasciculi, regeneration will occur in spite of a clumsy suture. Hence all depends upon the judgment of the operator as to how much tissue is resected from either segment. The inclination is to resect as little as possible in contemplation of the difficulties in bridging the defect. But this must be disregarded and the criterion always must be the appearance of the nerve on cross section. With a safety razor, section is made at intervals of 2 to 3 millimeters until the appearance of the cross section is that of normal fasciculi. It is surprising how completely the picture will change, when the sections are made but 2 millimeters apart, from one in which the fasciculi are embedded in scar tissue to one in which there appears to be no scar tissue at all (see Fig. 17). The variation in the number of fasciculi in the central and peripheral segments is usually very great; there may be 8 or 10 in the central segment of a musculospiral nerve and only 3 in the peripheral segment. The actual resection should not be begun until all is in readiness for suture. All bleeding should be controlled, the bed of the nerve prepared and if stretching is necessary to aid in bridging the defect, this may be applied by traction on the bulbous ends.

Suture. The final approximation of the divided segments may be accomplished alone

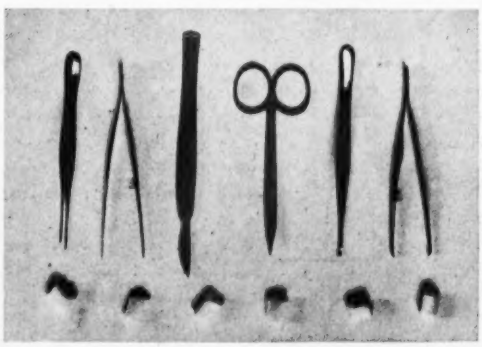


Fig. 12. Instruments used in nerve suture.

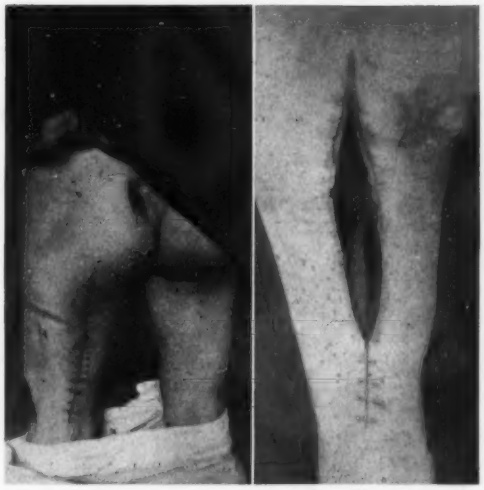


Fig. 10 (at left). Wound after débridement and Dakinizing before suture.
Fig. 11. Wound after secondary suture.

by through-and-through tension suture or together with interrupted sutures in the perineurium. We have employed the latter technique striving to secure accurate opposition of the sheath in the belief that by so doing, the neuraxes will be directed with greater certainty from the central to the peripheral segment. One through-and-through chromic catgut suture is used as a stay suture to prevent tension upon the fine silk perineural sutures and at the same time

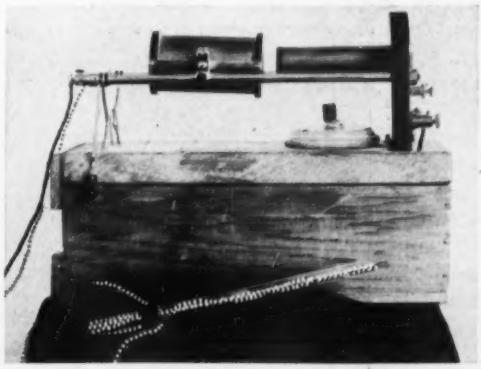


Fig. 13. Battery and electrode used in stimulation of exposed nerves at operation.

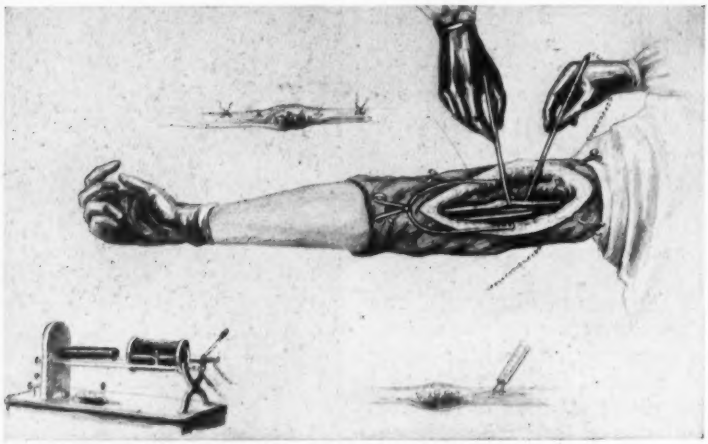


Fig. 14. Method of stimulating nerve exposed at time of operation.

to obliterate the space between the segments. If perineural sutures alone were used this space would fill with blood clot which when organized would offer a barrier to the passage of the new axis cylinders. Four to six silk sutures suffice to secure accurate apposition of the perineurium. There are two points in the technique of suture worthy of attention. In the first place the stay suture should not be tied, when there is any tension, until the perineural sutures are introduced and tied. To tie the tension suture first will cause the fasciculi to protrude on either side and make it difficult to keep them within the sheath as the perineural sutures are tied. This may seem to be a minor matter, but by observing this precaution a real difficulty in nerve suture will be avoided. The second point has to do with the prevention of rotation in suture and the preservation of nerve pattern. Before the nerve is dissected from its bed guide sutures of silk are introduced at corresponding points on the circumference of central and peripheral segments (see Fig. 18). If this precautionary measure is not adopted the operator can never be sure that, after the two segments have been freed a considerable distance above and below the lesion, there will not be some rotation. Whether the avoidance of rotation is of real or only of theoretical importance might be open to discussion. Langley[1] is of the belief that accuracy in apposition is one factor determining the degree of recovery. By distortion of the nerve pattern the central nerve cells, which

Case No.	Date of Admission
Name	Rank Co. Organ.
General Hosp. 11	Reg. No. Date of Exam.
Home Address	Age
DIAGNOSIS	
Electrode Uni — Bi.	
Level of Lesion	Nature of Lesion
Level of Stimulation	Operation
Level of Bifurcation	Operator

Muscles Key X O	Result R	Result L

Black — Cephalad, Caudad, Post., Ant.
White — Cephalad, Caudad, Post., Ant.

Pathological Findings

Fig. 15. Chart used in recording findings from electrical stimulation at operation.

[1] Brit. M. J., 1918, 1, 45.

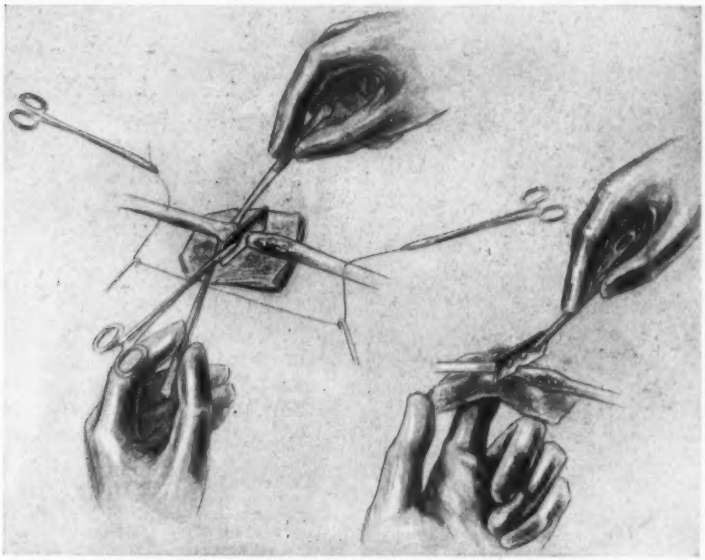


Fig. 16. Shows method of sectioning nerve with safety razor.

formerly controlled only a flexor muscle, may, after suture and regeneration, control flexor, extensor, adductor, abductor or rotator muscles in various proportions. If a sensory filament unites with a motor there may be a functionless union. Hence it is concluded that any procedure which reduces disturbance of nerve pattern will make recovery more complete and will shorten the time taken to procure that degree of recovery.

With careful suture of the nerve sheath all forms of so-called protection to the line of suture are not only unnecessary but we believe undesirable. Fascia, fat, the use of Cargile membrane, increase rather than diminish the tendency to connective-tissue formation. A suitable nerve bed is desirable and the best is an intermuscular plane. The old bed of scar tissue or flaps of muscle tissue are both objectionable. When a bed in the normal strata is not available there is no objection to transposing the nerve to a plane between the superficial and deep fascia.

The wound should be closed with interrupted sutures, tier by tier, in muscle, fascia and skin, as far apart as possible, so as to permit of the escape of lymph and serum that would inevitably accumulate were the sutures too close together. With this precaution drainage will be unnecessary.

In most instances the limb, forearm, or leg must be retained in a position of flexion to relieve tension. This position is secured by a lateral plaster-of-Paris splint. It has been our practice to maintain the limb in the position in which it was placed at the time of suture for from four to six weeks, four in the upper and six in the lower extremity. The limb is gradually brought into extension during the succeeding four weeks. Daily massage is given from the day the sutures are removed and galvanism is applied at the same time.

After suture of the sciatic and popliteal nerves the plaster-of-Paris splint is removed at the end of the second week and a light wire splint substituted (see Fig. 9). This splint permits of flexion of the knee but not of extension beyond the desired point. When the time comes to begin extension, this is regulated by daily straightening the splint a little.

SUMMARY

While in this discussion it has not been possible to take up the technical details as

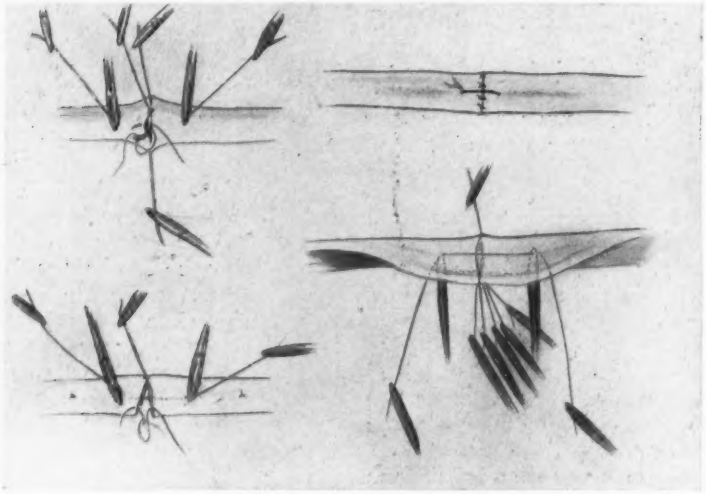


Fig. 18. Steps in technique of nerve suture.

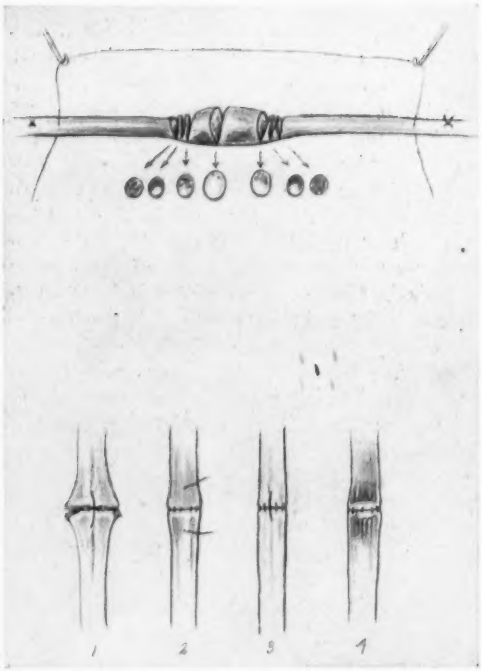


Fig. 17. Steps in technique of nerve suture.

applied to individual nerves, a summary is given in conclusion of the principles which have governed us in dealing with the problems applicable to all.

1. Liberation or neurolysis has been given preference in the absence of a complete anatomical division or a neuroma in continuity when after excising all scar tissue and laying bare the nerve sheath there is a quick response to faradism.

2. Resection and suture are essential whenever neurolysis is contra-indicated. Resection must be carried central and distalward until healthy scar-free fasciculi are exposed.

3. In bridging defects the nerve transplant must not be employed until advantage has been taken of every other reasonable measure: to wit, nerve stretching, immediate or continued (as with sutures through bulbs), mobilization, transposition as of ulnar and musculospiral, and in exceptional instances lateral implantation suture as ulnar or musculospiral into median.

4. When these fail a nerve transplant is justifiable, the autotransplant being the first choice, and homotransplant (preserved in vaseline, liquid petrolatum, or 50 per cent alcohol), the second choice. For autotransplant the musculocutaneous or sural nerves

Fig. 19. Patient with recovering paralysis of external popliteal nerve using jig saw for curative purposes.

of the leg, the radial or internal cutaneous of the arm, may be selected on the basis of convenience.

5. In nerve suture it is equally important to know what one ought not to do. In this category we include suture á distance, the flap operation, bilateral anastomosis (as recommended by Hofmeister) and tubulization.

6. Sharp clean dissection, careful hæmostasis, the approximation of healthy fasciculi, without undue tension, represent the tripod upon which the success of nerve suture rests.

Fig. 20. Handle of saw made to fit paralyzed hand by means of modeling compound.

7. Tendon transplantation should be employed when suture fails and is particularly appropriate in residual palsies of the posterior interosseous, with inability to extend wrist or fingers, and anterior tibial palsies with resulting foot drop.

8. The after-treatment should include (a) enforced fixation for a period of 4 to 6 weeks with gradual straightening of the limb, (b) massage and galvanism until voluntary movement returns, (c) exercises varied according to the muscles involved and with a view of sustaining the interest of the patient.

CHRONIC TRIGONITIS IN THE FEMALE

A New Method of Treatment; Preliminary Report[1]

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"IRRITABLE bladder" in women may be due to several causes; some extrinsic, some intrinsic. Among the extrinsic causes may be mentioned pressure by the gravid uterus, and uterine, ovarian, or pelvic, new-growths; distortion by extravesical new-growths; displacements by cystocele and prolapse and following interposition operations on the uterus; congestion, from general pelvic congestion due to inflammations, pregnancy, etc. Among the intrinsic causes may be mentioned inflammations, cystitis, primary or secondary to renal disease; new-growths; foreign bodies, including calculi, etc. In the past, an irritable bladder with no gross findings and a clear urine, was, for want of more accurate diagnosis, labeled, a "bladder neurosis," but today we know that a true neurosis of the bladder is exceedingly rarely, if ever, found. Bladder symptoms due to nervous diseases are usually of a very different type; dribbling, loss of control and retention, but rarely, if ever, irritability. According to Garceau "stammering bladder" and "essential incontinence" may be bladder evidences of a psychosis, but the term "irritable bladder" should be dropped. But there is a large and common group of cases, in which the main symptoms are those of bladder irritability with a clear urine and no gross intrinsic or extrinsic pathology to explain them. In these cases, careful examination with the cystoscope will reveal definite changes in the trigone as the chief pathological feature, and to this group of cases we apply the term cystitis colli or trigonitis.

Anatomy. The floor of the bladder is divided into two distinct portions: a part of the fundus behind, and the trigone in front. The trigone is the triangular area lying between the urethra in front and the two ureteral orifices behind. The base line is 2 to 2.5 centimeters long, a slightly elevated ridge (ligamentum uretericum, muscle band of Bell, bar of Mercier). The lateral boundaries are formed by lines connecting the ureters to the internal urethral sphincter. It is smooth, moderately red in color and, as Walther so well describes it, "sharply marked off from the yellow sand-like shore of the adjoining bladder walls." It varies somewhat in different individuals, in some being long and narrow, in others approaching an equilateral triangle.

Historical. Trigonitis was first described as a clinical entity by Knorr in 1900 and subsequently verified by a host of observers. There have been some who have denied that this condition exists as a clinical entity, but there seems to be a preponderance of evidence in favor of the existence of this condition as such.

Frequency. Knorr found 80 cases in 400 cases in his clinic complaining of bladder symptoms. Furniss says: "It is one of the most frequent bladder lesions in females; 30 per cent of the cases in the gynecological department have bladder symptoms and fully 90 per cent of these have cystitis colli, or trigonitis." Carey says: "One of the most frequent causes of bladder irritability is trigonitis." And Pilcher: "Many cases of chronic cystitis resolve themselves into a chronic trigonitis which leaves the patient with an irritable bladder for some time . . . . . It is frequently met with in cystoscopic work."

Etiology. The exact causes of this conditions are not known. Age seems to be of little significance. It impresses me as being a little more common in women near the menopause but I have seen many cases in much younger women. Parity also seems to be of no account. I have seen numerous cases in nullipara and when we consider that the majority of women over twenty have borne children, I should say that it is relatively as frequent or more so in nulliparous as parous women. Of the parous women it seems to occur proportionately

[1] Read before the Section on Obstetrics and Gynecology of the New York Academy of Medicine, April 22, 1919.

no more frequently in those with cystocele than in those with normal bladder support. Pilcher says that a chronic cystitis frequently resolves itself into a chronic trigonitis, but in the experience of Carey and myself, the converse, that trigonitis is frequently the result of a preceding cystitis, is certainly not true. Carey claims that trigonitis generally begins insidiously without any preceding bladder or other disease, and I fully coincide with this opinion. Garceau and Walther believe that it may be an infection from the start or be an infection grafted on a hyperæmia due to pelvic engorgement from accompanying pelvic disorders. Kelly and Byford have ascribed it to a hyperacidity due to improper metabolism, but I have seen typical cases of trigonitis with an alkaline urine. There is no satisfactory evidence that the gonococcus plays any important rôle in its occurrence and most cases show no evidence of recent or ancient gonorrhœal infection. Colon bacilli and staphylococci have been found in the catheterized urine by Carey, but these are frequently found in the urine of perfectly normal female bladders.

Pathology. The gross appearance of the trigone in this condition will be dealt with below in describing the cystoscopic picture.

The literature contains few references to the histologic picture. In a case curetted by Garceau, the curettings were submitted to "a Harvard pathologist," and the following description is given: "Situated immediately beneath the stratified epithelium of the bladder are numerous lymphocytes massed together in an area to form an area similar to lymphoid tissue. A few lymphocytes are seen in the stratified epithelium, but these are very few. The stratified epithelium is well preserved in the specimen; it shows an occasional mitotic figure, but there is little evidence of inflammation in the stratified epithelium. In some areas the aggregation of lymphocytes is situated immediately beneath the bladder stratified epithelium and this epithelium is intact. This shows chronicity of the process. The trigone is on the whole, smooth. There is abundant evidence of subepithelial inflammation." Veit says: "There is round-celled infiltration, vascular proliferation, epithelial hyperplasia, desquamation and cyst formation. "Legneu describes it as follows: "Vascularization of the mucosa, epithelial cyst formation, and even leucoplastic transformation of the epithelium. At first there is a local hyperæmia contrasted with the normal bladder mucosa, later a thickening of the mucous membrane even to proliferation and formation of papillæ and warts."

Symptomatology. The onset is generally insidious with gradually increasing frequency of urination, especially by day, but somewhat also at night. With this there is usually no pain, but at the end of the act of urination there is generally a sensation of incompleteness and a desire to pass more. The patient will empty her bladder and within two or three minutes have an uncontrollable desire to urinate again, which usually, if yielded to, accomplishes nothing, or at most only a few drops are expelled. There is an almost constant desire to urinate and many patients complain that by day they are obliged to relieve themselves as often as every 5 minutes, voiding only a few drops each time. As this condition progresses the patient becomes more and more miserable, all work, meals and even sleep are interfered with and the patient is obliged to devote her entire time to emptying or trying to empty her bladder. In these later stages there may be some pain, but it is rarely very severe, and, occasionally, there may be a slight terminal hæmaturia. The chief complaint of these patients is the constant desire to urinate and the sensation of never completely having relieved themselves.

Course and prognosis. Furniss says: "It may last for years"; and Sommers: "With remissions it may last indefinitely." Garceau mentions a case that continued for 10 years, and the patient was in a pitiable state for loss of sleep. Fortunately these severe cases are not very common. But almost every patient states that she has had these symptoms for years and that they are gradually but progressively increasing.

Cystoscopic findings. The bladder capacity is generally considerable, often large, and the walls outside of the trigone of a normal pink-

ish yellow color with clearly defined branching blood vessels; occasionally there appears to be a moderately increased vascularity. If the cystoscope be pushed well into the bladder then turned to bring the base into view and gradually drawn forward, we get a view of this normal bladder wall up to the posterior limit of the trigone where we come to an abrupt change sharply demarkated by the interureteric ridge. In front of this ridge the mucosa of the trigone is swollen, dark red, intensely angry looking, and cloudy. The vessels are usually fine and small and can be seen extending backward almost parallel to each other but their contour is far less distinct than in the remainder of the bladder wall. The normal yellow mucosa cannot be seen between the vessels as in simple hyperæmia. (Knorr.) Scattered red spots which resemble ecchymoses may be seen (Garceau). I have frequently noticed small red spots especially toward the posterior limit of the trigone which appear slightly raised and are sometimes very close together. They vary in size from mere specks to a poppy seed and the trigone appears to be studded with little knots of very dark red silk. The mucosa is distinctly thickened and velvety, and as Walther says "a catheter sinks into it revealing rosy, satiny, non-transparent hypertrophied papillæ." Knorr claims that occasionally minute cysts may be present. Not infrequently the papillary hypertrophy proceeds to formation of small polypi (Legneu). Carey claims that the trigone bleeds easily at a slight touch of the cystoscope, but I have not been able to verify this. I find that the trigone in trigonitis is particularly resistant to trauma and can be made to bleed only with difficulty. Whitish or yellowish white areas in the congested region due to cellular metaplasia are rare, but these cases are particularly intractable to treatment in the opinion of Furniss and Carey. This I am able to confirm but can report very encouraging improvement in the two cases of this nature which I have had opportunity to treat by the method here described. The posterior part of the sphincter and frequently the adjacent portion of the urethra are similarly involved, and at times small fissures occur in the sphincter. With the cystoscope at close range and short focus, the mucosa can be seen to be extremely thick, velvety, translucent, almost œdematous, and this appearance is especially well brought out if a fold of the mucosa is caught and lifted on the point of the needle. The ureteral orifices are generally normal in appearance.

TREATMENT

Rest in bed, diet modifications (Byford) bladder irrigation and installations have all been tried with varying degrees of temporary success. Hunner has advised the continuous bath. The consensus of opinion is that the treatment proposed by Knorr gives the best results of any so far proposed. Knorr's latest treatment is as follows: rest in bed, light diet, forced fluids, hexamethylenamine, santol and boric acid by mouth. After irrigation with bland fluid, 20 cubic centimeters of eucaine solution 2 per cent is introduced through a catheter into the bladder, and as the catheter is withdrawn, into the urethra. Anæsthesia develops in from 2 to 5 minutes. A tubular endoscope is then introduced and the bladder drained and mopped dry with sterile cotton-wound applicators. A similar applicator with silver nitrate solution 1 to 5 per cent is then introduced and the endoscope withdrawn. The bladder contracts in a spasm on the applicator squeezing out the silver solution over the bladder floor. The applicator is withdrawn after 30 seconds, thus at the same time medicating the urethra. Garceau elaborates this treatment as follows: In addition to carrying out Knorr's treatment, polypi should be removed with snare or cautery, fissures should be dilated and touched with silver nitrate fused on a probe, cysts should be punctured with the electro cautery, and ulcers cauterized with silver nitrate solution, 10 per cent. If this treatment fails a vesicovaginal fistula may be formed at the vesical neck and the trigone scrubbed with a tooth brush, the bristles of which have been cut short in order to render them as stiff as possible, or the trigone may be curetted. He acknowledges that the results of this ultraradical treatment have not been satisfactory. Kelly, in dis-

cussing Garceau's paper, stated that he had attempted injections of novocaine into the vesicovaginal septum but with no benefit. I have used Knorr's treatment repeatedly and am obliged to state that the results have been far from satisfactory. Treatments are necessary two or three times a week, repeated over a long period of time, sometimes for as much as 6 months. Some relief is usually obtained, but there is almost bound to be a recurrence not long after cessation of the treatment.

For this reason, in 1916, having several of these patients under my care in my clinic, I attempted to devise a treatment that would give better results. Very little was to be found in the literature concerning the etiology or pathology of this condition, but the outstanding feature of the cystoscopic picture was the intense congestion, hypertrophy, and hyperplasia of the subepithelial blood vessels and the swollen mucosa. Could anything cause the destruction or at least constriction or compression and thereby reduction in size and possibly in number of these blood vessels? I knew that quinine and urea hydrochloride solution when injected into the tissues for production of local anæsthesia frequently, especially in strength of over 1 per cent, caused a deposit of fibrin and a considerable induration at the point of injection, which induration not infrequently remained for months. Constriction of the vessels in the tissue must result, to what extent remained to be investigated, but I had personally observed a complete gangrene and necrosis of the terminal phalanx of the thumb where 2 per cent quinine and urea hydrochloride had been injected at the base by the Oberst method, and a ring of indurated tissue remained at the site of injection for weeks. Evidently this ring of deposited fibrin had so constricted the vessels that the circulation was interrupted and gangrene ensued. I therefore decided to try injections of this solution into the trigone, beginning with weak solutions to observe the effect, not knowing but what strong solutions might cause necrosis of the mucosa, and gradually increase the strength if no harm resulted. In my earlier attempts I used a Kelly cystoscope, electrically lighted, with the patient

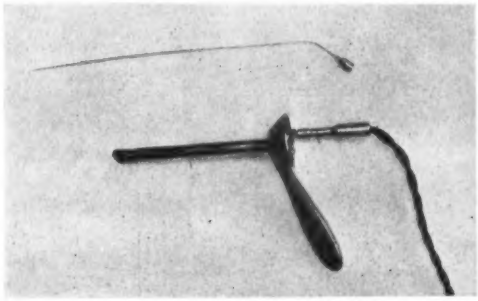

Fig. 1. Electrically lighted Kelly cystoscope and original needle.

in the knee chest position. I had a special needle constructed similar to the one illustrated (Fig. 1), but shortly found that the needle was so frail that it wobbled and could not be introduced at the desired point. Furthermore the needle was so flexible that, when pressure sufficient to make it enter the tissues was made, it bent and doubled and accuracy of manipulation was absolutely impossible. Then by degrees a needle was evolved for use with the Brown-Buerger cystoscope and with this I succeeded in making my injections and obtaining results that were most gratifying. The technique is not easy, in fact, quite difficult, and it has been only after repeated efforts that I have finally succeeded in making the injections where desired. Very little pain is given the patient and if she be reasonably tolerant a fairly large area can be injected in one sitting. Usually, however, several treatments, three to six, are required, but the relief from even the first treatment is so prompt that the patient readily consents to another sitting.

Description of instrument. *A* in Figure 2 is a long flexible needle of No. 28 gauge fitted with a threaded end for attachment to a hypodermic syringe or preferably to an adapter which fits an all glass syringe with a slip joint. *B* is a hollow cannula of inside dimension just sufficient to allow the needle to pass through it without binding. The outside dimension is of about the caliber of an ordinary ureteral catheter. It is made of the same tubing that is used in "reinforcing" hypodermic needles. At the proximal end there is attached a small

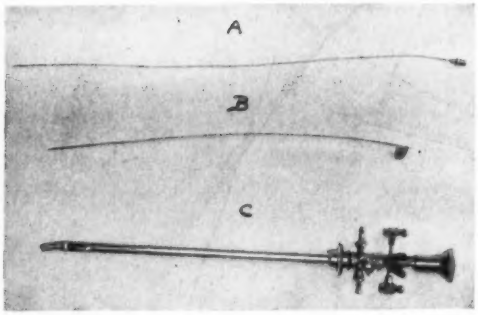

Fig. 2. Brown-Buerger double catheterizing cystoscope, needle and cannula. *A*, Needle; *B*, cannula: *C*, cystoscope.

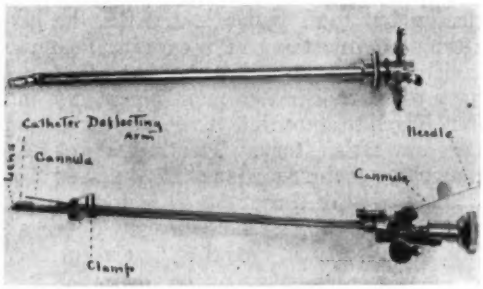

Fig. 3. Above, Brown-Buerger cystoscope sheath. Below, catheterizing telescope with cannula and needle in position for introduction into sheath. Note that the point of the needle is within the cannula and that the latter is held by the clamp so that the distal end lies on the catheter deflecting arm.

metal tab to serve as a finger grip. I found that if I attempted to introduce the needle without this protecting cannula the needle point would catch and bend against the movable directing arm of the cystoscope.

Technique of injection. The patient is prepared as for an ordinary cystoscopy and ureteral catheterization, about 200 cubic centimeters of sterile water being left in the bladder.

The instrument is sterilized in the usual way, the needle and cannula are boiled. The cannula is then fitted into the catheter channel (right or left) of the catheterizing telescope and pushed on until the distal end rests on, but not beyond, the movable catheter directing arm (Fig. 3). With the cannula in this position the needle is threaded through it until the point of the needle lies just *within* its distal end.

The cystoscope is then introduced into the bladder, the obturator withdrawn, and the prepared catheterizing telescope inserted. If necessary more fluid can be allowed to enter the bladder. With the light turned on and under the guidance of the eye, so as to avoid any possibility of injury, the cystoscope is pushed on into the bladder, rotated until the lens is down (faces the trigone) and the ocular end depressed until the vesical end can be seen to have been elevated well away from the bladder floor. The cannula is then pushed forward until the distal end enters the field of vision. The needle is now pushed forward through the cannula until the point is well into, but not beyond, the field of vision. Holding the needle in this position the cannula is withdrawn until well out of the field of vision (Figure 4). This will leave about one-half inch of the needle free beyond the cystoscope sheath, and lying flat against the directing arm entirely within range of the eye and under constant observation and control. The cystoscope is now manipulated to bring the trigone into view, the point of injection determined, the directing arm controlling screw turned, elevating the arm and directing the point of the needle downward toward the trigone (Fig. 5). The syringe filled with the solution is then attached to the needle and some of the solution ejected until seen to flow in a fine blue stream from point of the needle indicating that all air and water have been expelled. The needle is then made to enter the trigone at an angle, at the point desired, by manipulation of the cystoscope and two or three drops of the solution injected. A blue weal, sharply defined, will be seen to form. Should the blue fluid escape at the point of puncture it will indicate that the orifice at the oblique point of the needle has not completely entered the tissues. The tissue is soft and elastic, and can be seen to push ahead of the needle as the latter enters it. The whole point of the needle may disappear from view in this velvety mucosa and give the impression that it has entered the tissues. But when the blue solution is forced through if it is seen to float off in the surrounding fluid it is proof the needle point is not buried.

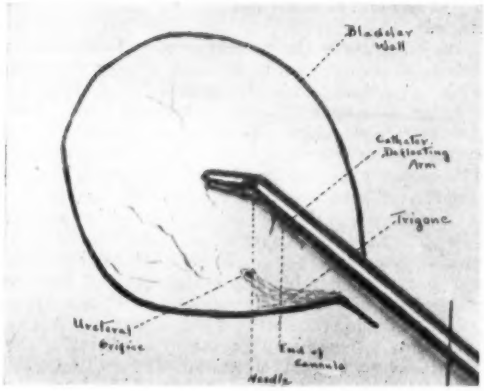

Fig. 4. The cystoscope in the bladder, first position. Note that the ocular end is depressed and the distal end elevated well away from the bladder floor. The needle point has been pushed beyond the end of the cannula well into the field of vision.

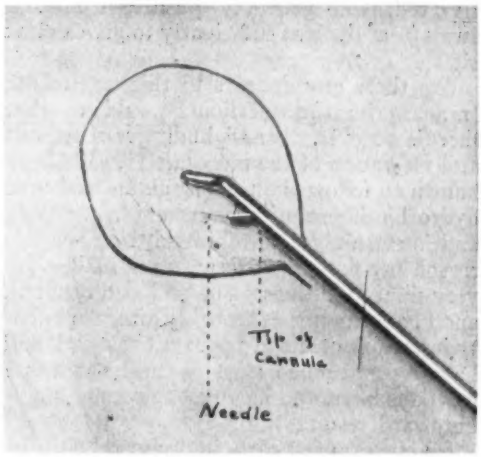

Fig. 5. The cystoscope in the bladder, second position. Note that the cannula has been withdrawn, the needle pushed on still further and the catheter deflecting arm elevated bending the flexible needle toward the bladder floor.

The needle is then withdrawn and entered elsewhere until as much of the trigone as is desired is infiltrated. I generally begin close to a ureter and work across the trigone in a line, and then work back across the trigone a short distance in front of this line. This is continued as far forward as desired. It is advisable not to make the injections too close together. On seeing the weal form about the needle in the form of a circle the next site of injection should be so chosen that each new weal formed will abut on the one preceding it. I begin at the posterior margin because blood rises as a screen from the punctures and obscures the field; therefore by working forward we keep in front of this screen. Of course hot continuous irrigation will tend to check the bleeding and help keep the field clear.

Solution. This consists of a sterile 2 to 3 per cent solution of quinine and urea hydrochloride in normal saline. It is colored rather deeply with methylene blue. For convenience I keep the solution in ampoules of 5 cubic centimeters. In future I shall add a small amount of a suprarenal extract to the solution in the hope of reducing the oozing.

For intravesical anæsthesia preliminary to fulguration of polypi, removal of specimens, dilatation of ureteral orifices, etc., for which this instrument readily adapts itself, I would recommend that weaker solution be used. These strong solutions are not necessary for anæsthesia, the weaker will answer just as well and the infiltration and danger of possible necrosis will be avoided. Other solutions than quinine and urea hydrochloride may also be used.

Site of injection. As described above, I begin near one ureteral orifice and work across the trigone, then in a second line back across to the side at which the start was made. This is continued to and into the sphincter and even the posterior urethra. Ordinarily four or five injections will be sufficient for the width of the trigone and only about four or five rows from behind forward are necessary. It is remarkable how little discomfort the treatment occasions, but it is even more remarkable how great, although temporary, a relief can be brought about by an injection of only 2 or 3 minims just in front of each ureter, leaving the balance of the trigone entirely untouched. This is probably a direct result of the anæsthetic effect of the quinine. It may be more convenient to use the convex or close vision cystoscopic sheath for the injections near the sphincter and in the adjacent urethra, but I have not found it necessary. The catheter deflecting arm, when

elevated, will generally push the mucosa away from the lens sufficiently to give a clear view.

Are there any dangers to this treatment? In answering this question I would say that there is undoubtedly a slight danger of necrosis and ulceration of the mucosa. This has been known to follow the use of quinine and urea hydrochloride solution elsewhere in the body and is certainly a possibility here. For this reason my first experiments were made with very dilute solutions. But no harm resulted, and I have now made probably fifteen or twenty injections of the 2.5 per cent solution, and have recystoscoped most of these patients a few days later, and have yet to see one single untoward result.

On one occasion early in my work with the Brown-Buerger instrument I was unfortunate enough to break off a piece of needle three-quarters of an inch long in the bladder. But with a Kelly cystoscope and an alligator forceps I had no trouble in removing it. This is the only mishap I have had.

Results. These have been most encouraging but, owing to the general upset in the clinic due to the absence of my first, second, and third assistants who were in service and the shortage and frequent shifting of nurses on account of the war and epidemic, all of my records have been either mislaid or thrown out. I can therefore cite but one typical case, that of a private patient, and give a general outline of my observations and impressions.

Mrs. I. D., age 30; violinist. The patient had typhoid in 1914. The menses were always regular, four-weekly, and painless. She has been married since 1911. She has no children, but had one miscarriage at 2 months shortly after marriage, at which time she was curetted, and had a slightly febrile convalescence. She miscarried again in September, 1915. The ovum projected from the cervix. It was extracted by me. She was not curetted, and had an uneventful convalescence. Complement fixation test was negative for gonorrhœa and syphilis. She first consulted me for bladder symptoms four months later. For the past two weeks, the patient had suffered day and night from frequent urination. There was slight burning at the end of the act with an urgent desire to urinate again. The urine was clear. The uterus was small, hard, retroflexed, but freely movable. A Smith pessary was inserted and a mixture of sodium bicarbonate and belladonna prescribed. This relieved the burning at the end of urination, but the frequency continued.

In June, 1916, the patient reported as follows: Urination every two hours and oftener by day, with sensation of bladder always being full, no burning. Urination twice at night, about 3 and 6 a.m. A specimen of urine was absolutely negative. A cystoscopic examination was made one month later. The capacity of the bladder was large, the fundus negative. There was a marked velvety and granular appearance of the trigone and marked congestion. The patient then disappeared from observation, until February 15, 1919. She then stated that since her last visit her bladder symptoms had become markedly worse. She was obliged to urinate every half hour during the day, and five or six times during the night. There was a constant sensation of the bladder being full and a constant desire to urinate. At times this became most urgent and she was compelled to yield to the desire, but she obtained no relief. There was no pain. This urgent desire to urinate was most annoying and interfered greatly with her vocation as violin soloist.

A catheterized specimen of urine was clear, amber colored, acid, specific gravity 1.011. Albumin, sugar, acetone and bile pigments were absent. Indican was normal in amount. There were no casts; cylindroids; mucous, amorphous, or crystalline deposits; pus, red blood cells or bacteria. There were present a few squamous cells.

Cystoscopic examination, February 18, 1919, showed the condition to be practically the same as at the previous examination except for the presence of two or three lentil-sized, pale yellowish patches. These were probably areas of metaplastic cell proliferation. At this examination the trigone close to the ureters and these patches were injected with 2 per cent quinine and urea hydrochloride solution but owing to the constant oozing and clouding of the field, treatment was not completed.

Two days later the patient reported that she had complete relief and for the first time in three years was comfortable and had been able to sleep through an entire night. She then went on a concert tour and did not report again until April 4. She then stated that she was greatly relieved for several days when the condition gradually recurred. She is not as uncomfortable as before, urinates only every two hours during the day and about twice at night. There is still a sensation of the bladder being full but, after urination, the sensation of incompleteness is entirely relieved.

On April 7, cystoscopy showed the trigone to be about the same as before except that the patches were white instead of yellowish, and the site of the previous injections stood out yellow, like normal bladder wall, with a few small vessels coursing across them, and surrounded by the intensely congested trigone.

The entire interureteric ridge, the trigone and sphincter were infiltrated with quinine and urea hydrochloride solution 2.5 per cent. Only a few

small areas were omitted. The oozing was controlled by hot irrigation. The patient, a few minutes after the treatment, said that she felt greatly relieved.

On April 22, fifteen days later, the patient reported that she was completely relieved of the feeling of fullness, the sensation of incompleteness, and the urgency. She still had to urinate during the night, but generally only once, and only about every three or four hours per day.

There have been no bad results, no failures, even at the very beginning when I was using only 0.5 per cent solutions and the Kelly cystoscope. The patients acknowledged that they had received instant relief, but that it had lasted for only a few hours or at most three or four days. After the stronger solutions were used the relief was again instantaneous but of considerable duration. I believe that the instantaneous result is due to the anæsthetic effect of the solution, the prolonged result to the destruction of the vessels and nerves by the pressure of the fibrin deposited about them. I wish to emphasize here that this solution is not used as an anæsthetic—such effect could at best be only temporary—but I am using and advising the use of this particular solution because it is known to cause a marked infiltration of the tissues with fibrin which will compress, obliterate and destroy the vessels and probably also the nerve fibers which pass through it. It is in this way that necrosis occasionally occurs when quinine and urea hydrochloride are used elsewhere in the body. Some day necrosis in the trigone may result from one of these injections, but so far I have not seen such an occurrence. The infiltration does occur, and that is exactly what I want. It seems to have no ill effects. How long it remains I do not know and apparently that is of little consequence. However, it does cause a disappearance of the excessive vascularization of the trigone and the symptoms of bladder irritability and this is the end sought.

Several of the patients came back once or twice to report marked improvement, and stated that they were so well that they "didn't need further treatment." Several allowed themselves to be recystoscoped that I might observe the results and in each case the area of injection was plainly discernible for long periods after. The areas where the weal had been stood out as a pale yellow spot, resembling almost normal bladder wall, surrounded by the diseased, angry looking mucosa. Strange to say even though the area injected was only a small part of the trigone much relief was experienced. One patient who had had several treatments during which the entire posterior half of the trigone was injected kept herself under observation for about three months. During this time she was perfectly well. I have not heard from her in over a year but I think I may safely say that, considering the good result in her case for which she was most grateful, she would probably have returned for further treatment had there been any recurrence.

On the whole I have been very favorably impressed by the practically unanimous verdict of these patients that they had been greatly relieved for a considerable period of time, a result that I had never been able to obtain with Knorr's generally accepted method.

Owing to the upset in my clinic and the extra work placed on me by the war conditions I have been unable to pursue this work to the extent that I had hoped. I realize that the cases are few in number and have not been observed steadily nor long enough for reliable or final conclusions. I do not wish to recommend this treatment as infallible nor appear too sanguine as to the results, but I personally believe that it gives promise of holding out to a marked degree distinct prospects of relief from this extremely intractable and miserable affliction. I, at least, and I hope others, will continue investigations along this line, until experience in a much larger number of cases gives us data that are really worth while accepting.

In conclusion I wish to sincerely thank my assistants, and especially Drs. I. Kross and A. Unger, for their kind assistance in the furtherance of this work and J. E. Kennedy & Co., for kind suggestions and co-operation in the development of the needle and cannula.

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THE DEEPER STRUCTURAL CHANGES ARISING FROM VARICOSE ULCERATION

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WHILE it is well known that varicose veins of the leg regularly cause an impaired nutrition of the skin and subcutaneous tissues, which readily become ulcerated, the fundamental changes in other structures remote from the ulcers are not generally recognized. And yet these changes quite regularly accompany the process when this is of long duration, and are so striking and significant as to deserve emphasis. It is quite to be anticipated that the tissues underlying an excoriation of the skin should be infected to a greater depth than the level of the granulation covering the floor of the ulcer. Especially would this be apt to be so when the ulcer became chronic. If then it occasionally happened that the bone immediately underlying such an ulcer showed signs of involvement, it would excite little or no surprise. We might expect a mild grade of local periosteitis, indeed, beneath most chronic ulcers. But this is not what happens, and it is most unusual for a periosteitis or osteomyelitis to localize beneath even an ulcer of moderate depth. Instead we have far-reaching changes. The tibia or fibula, and usually both, are involved in a periosteitis and osteomyelitis so diffuse as to extend throughout the entire shafts and involve even the epiphysis, so chronic as to pass unnoticed by the patient and occasion little or no pain. The inflammatory process which results in the most extreme structural changes never apparently reaches the stage of abscess formation, and if suppuration exists its products are absorbed into the system. Accompanying this are widespread vascular changes. The deep vessels, posterior tibial and peroneal, show marked calcification, which extends to the popliteal or above. This sclerosis occurs independently of the site, size, and depth of the ulcer, but is most marked in those cases in which ulceration has been present for a very long time.

Such striking changes occurring with regularity in a large series of cases and not dependent upon any discoverable constitutional disease at once arouse a question as to their mode of production. So far as concerns the bony changes it might be supposed that bacteria working into the depths of the wound invade the periosteum and travel beneath this to remote portions of the bone. This hypothesis fails, however, to explain why there are often little or no signs in the X-ray of bone involvement just beneath the ulcer, whereas the changes may be marked at the other end of the bone.

Furthermore, it becomes obvious that this is not the mode of production, when we find that the process is not confined to the bone over which the ulcer lies, but that changes of equal extent are present on the opposite side of the leg. Thus, we may see an ulcer over the inner aspect of the tibia with pronounced

Fig. 1. Case 1. Roentgenogram of left leg showing slight diffuse periosteitis; no calcification of vessels. Marked varicosities but relatively slight ulceration.

Fig. 2. Case 1. Roentgenogram of right leg showing marked osteitis of fibula and some involvement of tibia. Calcification of posterior tibial vessels.

osteitis of the fibula. Some more general distributory agent than the cellular tissue must operate to produce such changes.

The solution of the problem is probably furnished by the extensive vascular changes which quite regularly accompany these cases. The advanced arteriosclerosis of the tibial and peroneal vessels, which appear in nearly all the X-rays as calcified tubes, indicates that the pathway of infection has probably been here.

This condition of the deep arteries of the leg at once arouses the thought that the logical method of bacterial distribution to remote parts of the bone is via the arterial wall and the adjacent lymphatics. The mechanism then would appear quite simple and be somewhat as follows: The lymphatics draining the ulcerated area sooner or later become the seat of a chronic lymphangitis which extends proximally, not only via the superficial lymphatics to the femoral nodes, but also via the deep lymphatics which

Fig. 3. Case 1. Ulcer of the posterior crural region of the right leg, of five year's duration.

Fig. 4. Case 2. Superficial ulcer of anterior crural region of right leg. The ulcer has been present at intervals for 20 years. Slight excoriation of the left leg has been present for one year, with marked eczema and extensive varicose veins of both legs.

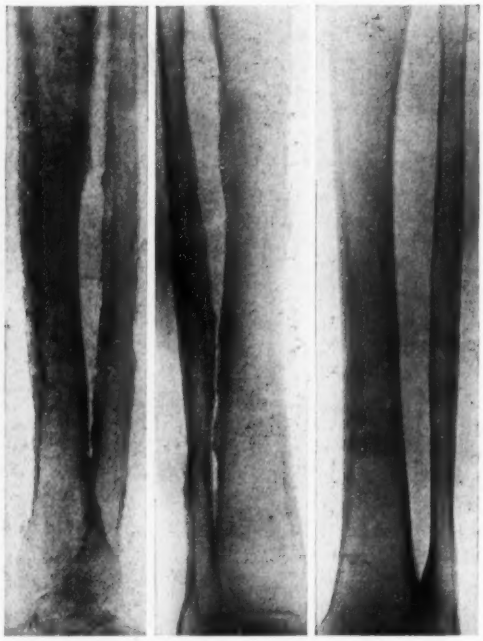


Fig. 5 Fig. 6

Fig. 5. Case 2. Roentgenogram of the right leg showing extensive periosteitis and osteomyelitis of both bones with narrowing and irregularity of marrow cavity. Calcification of vessels has been present but has not been marked.

Fig. 6. Case 2. Roentgenogram of left leg showing slight calcification of vessels. Little or no bone changes.

communicate with the above and lie in close relation to the deep vessels of the leg. Given a chronic lymphangitis of the perivascular lymphatics, and it is easy to see how bacteria migrating through the delicate lymphatic wall soon penetrate the walls of the adjacent artery and vein. This takes place throughout the full extent of the vessel in the leg, and hence the nutrient arteries to the tibia and the fibula may become simultaneously involved. The bacteria may then penetrate the walls of the nutrient vessels and thus be distributed to all parts of the bones, or we may postulate a retrograde lymphatic infection against the normal lymphatic current. Either process seems reasonable and probably both occur. Thus we find an explanation for even the most extensive changes in bone and artery.

During this time the body has manufactured antibodies sufficient to prevent the spread of the infection, but not sufficient to prevent damage to the tissues from the continued presence of bacteria. It is well known that calcification is often a late result of chronic infection. The calcified areas in tuberculous foci, old abscesses, chronic infections of the lymph-nodes, bursæ, and joints, syphilitic aortitis, and thrombophlebitis, as well as concretions, biliary, renal, etc., which have been definitely shown to be originated by bacteria, are only a few of the numerous examples of this process. In view of this it is easy to see how the calcification of the vessels and the structural alterations of the bones would be simply a logical result of the continued absorption of bacteria from a chronic ulcer. Some interesting speculations are, however, aroused by these conclusions: Are more vital structures injured in a like manner? To what extent is arteriosclerosis in general dependent on bacterial absorption, and to what degree is the aging of other tissues influenced by similar processes?

Fig. 7. Case 3. Photograph of leg showing marked varicosities and thrombophlebitis. Over the anterior crural region is a small depressed scar of a healed ulcer. The varicosities have been present 15 years, the ulcer 6 years. The opposite leg shows similar changes but less marked.

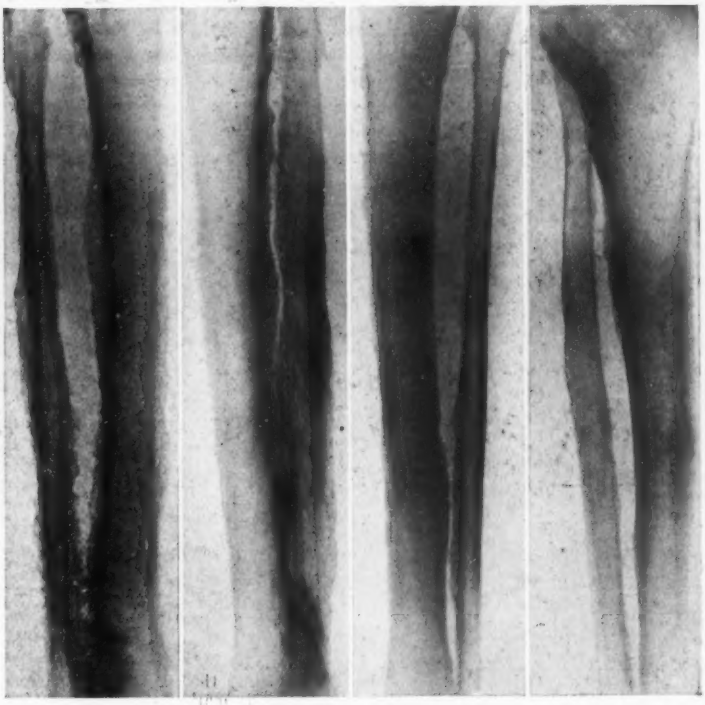


Fig. 8 Fig. 9

Fig. 8. Case 3. Roentgenogram of leg shown in Figure 7, showing extensive productive osteitis of both bones with involvement of marrow cavity.

Fig. 9. Case 3. Roentgenogram of opposite leg. The bone changes are much less marked. This corresponds to the lesser severity of thrombophlebitis on this side.

These are problems worthy of further study. It may well be that kidneys, heart, and nervous system are damaged in a like manner by the insidious influence of cryptic infections. The prompt recognition and vigorous eradication of such lesions would then be regarded as essential to the prolongation of life.

The following cases, illustrating the pathological processes outlined above, represent merely a few of the large number studied. In the entire series the changes were the same, differing merely in degree. They were always more marked in the leg showing the worst varicosities or the most prolonged ulceration and were regularly absent in the opposite extremity if this was free from varicose veins. The photographs of the X-ray plates of these cases are of necessity greatly reduced and fail to do justice to the originals in which the osteomyelitis is shown with great clearness.

Case 1. Louisa M., for five years the patient has had ulcer of the posterior crural region of right leg, extending over an irregular area 4 inches in diameter. The margins were irregular. The ulcer was slightly depressed; the floor covered with grayish and greenish slough and unhealthy granulations. At no point is there any sinus penetrating into the deeper structures, and the floor of the ulcer is everywhere firm. There are scattered islands of healthy skin, but the crural region and the dorsum of the foot are somewhat œdematous. There are moderate varicosities of superficial veins, including internal saphenous, above the ulcer. The Wassermann was negative with both antigens. The pulse was very poor in the dorsalis pedis artery. The opposite leg shows moderate varicose veins and brownish pigmentation, but no ulceration is present. Urine: specific gravity 1015;

Fig. 10 Fig. 11

Fig. 10. Case 4. Roentgenogram of Figure 10, showing extensive changes in both tibia and fibula. The tibia is greatly thickened, the marrow cavity appears partly obliterated in both bones. There is marked calcification of the vessels which are covered by shadows of the bones.

Fig. 11. Case 4. Roentgenogram of left leg showing absence of marked bone changes. There is extensive calcification of the vessels.

reaction, acid; albumin, faint trace. Microscopic examination shows large numbers of bacteria, discrete and in clumps. There are a few white blood cells and epithelium. The ulcer progressed favorably under local treatment and baking and massage. X-ray examination of right leg (No. 65569) shows marked bony changes throughout fibula and tibia, most marked over lower half of fibula which is greatly thickened and shows nodular periosteal excrescences. The cortex is greatly thickened and the narrow cavity encroached upon. Similar changes are present in the tibia but to a less degree. Marked calcification of posterior tibial vessels of right leg. No similar changes in left. The Wassermann was negative with alcoholic and cholesterin antigens.

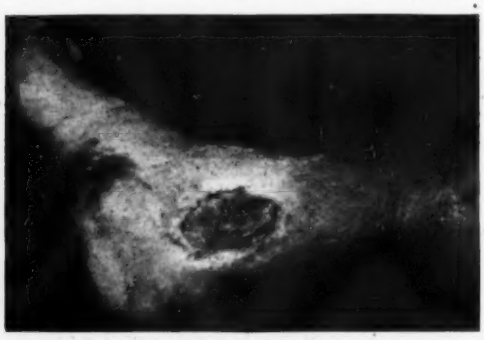


Fig. 12. Case 4. Superficial ulcer of the medial crural region of the right leg which has been present for 25 years. There are marked trophic changes in the skin of the foot. Extensive varicose veins are present. The opposite leg has a pigmented scar of healed ulcer and moderate varicosities. There is no recent ulceration.

CASE 2. John F., age 69, plasterer. This patient had ulcers of the anterior crural region, about which there was marked eczema. An ulcer of the right leg had been present at intervals for 20 years, of the left leg for one year.

The right leg was greatly swollen, reddened, and covered with crusts. There was a large irregular ulcer 4 x 2 inches in diameter over the anterior crural region of the right leg. The left leg was reddened and scaly but not ulcerated. There was considerable thickening of both legs. Varicosities of internal saphenous on right side were present.

Fig. 13 Fig. 14

Fig. 13. Case 5. Roentgenogram of Figure 15, showing extensive periosteitis and osteomyelitis of entire fibula. The tibia is involved to a less extent. Calcification of the vessels present.

Fig. 14. Case 5. Roentgenogram of opposite leg showing no bony or vascular changes. There are no varicose veins or ulceration of this leg.

There was a systolic murmur over the aortic area. Urine: specific gravity, 1027; reaction, acid; albumin, very faint trace. Glucose, positive. Microscopic examination showed epithelial cells and a large amount of bacteria. The Wassermann was negative.

CASE 3. Henry S. The patient had had varicose veins of both legs for 15 to 20 years. He had had pain in both legs for one year. There was an ulcer of the left anterior crural region six years ago but this is now healed. There was extensive thrombophlebitis of the superficial veins of both legs, especially on the right side. The veins were greatly dilated, containing hard nodules resembling phleboliths. X-ray examination showed extensive periosteitis and osteoyelitis in the bones of the left leg. The Wassermann was negative with both antigens.

CASE 4. James O'Brien. An ulcer had been present over the medial crural region of the right leg for 25 years. The ulcer was about 2 inches in diameter, superficial and located just above the internal malleolus. The skin about this was thickened and the papillæ were hypertrophic. The base of the ulcer was pale and grayish. The pulse was poor in dorsalis pedis. The toe-nails showed trophic changes; onychogryphosis; leg and foot were swollen and the ankle stiff. The skin was unhealthy and pigmented. The skin of the opposite leg was thickened and pigmented. Pulse in the

Fig. 15. Case 5. Shallow ulcer of the lateral crural region which has been present for 15 years. There is extensive eczema and elephantiasis of the skin. Varicosities are marked along the distribution of the internal saphenous vein.

Fig. 16. Case 6. Roentgenogram of a leg which has been the site of an ulcer, 2 by 3 inches in diameter, for 20 years. Photograph of leg not available. Extreme periostcitis and osteomyelitis of both bones and calcification of the posterior tibial vessels present. The opposite leg appears normal on X-ray examination.

Fig. 17. Case 7. Shallow ulcer of the right anterior crural region which has been present 4 years. There are extensive varicose veins and eczema of both legs.

dorsalis pedis was likewise poor. Urine: albumin very faint trace; few clumps white blood cells. Hypertrophy of prostate. Blood pressure: 210 systolic; 100 diastolic. The Wassermann was negative with both antigens. The ulcer was very sluggish; no progress toward healing has been made in spite of careful and continuous treatment. X-ray examination of right leg showed very marked bony changes in both tibia and fibula. The tibia was thickened throughout, especially in the lower half which resembled a club. There was extensive periosteitis and osteomyelitis. The marrow cavity appeared obliterated by dense bony proliferation. Calcification of posterior tibial vessels was marked. X-ray examination of left leg showed bones normal, and marked calcification of deep vessels.

Case 5. Louis Barteldes, age 55; driver. The patient has had an ulcer of the lateral malleolar region for 15 years. The ulcer was about 1 by 1.5 inches in diameter, superficial and surrounded by thickened hyperplastic skin. The entire leg was thickened and somewhat œdematous over the lower part. The soft parts were thick and tough from the presence of increased fibrous tissue. The bones were palpably thickened. There was little or no pain in the leg, and no disability. The patient has varicose veins of both legs and marked eczema. Blood pressure: systolic, 175. Pulse, 35 to 40 beats to the minute. The cardiac rate was the same. Second aortic sound accentuated. Area of cardiac dullness enlarged. The Wassermann was negative with both antigens.

Case 6. Theresa R., age 63, housework. The patient has had an ulcer of the anterior right crural region for 20 years or more. She has extensive varicose veins. There were no symptoms except pain and swelling of the leg. There was an ulcer over the middle of the tibia, 3 by 2 inches in diameter, with a sinus which passed to the bone. The leg was greatly swollen and œdematous. There was an enlargement of the entire leg apparently due to bony thickening. The opposite leg was normal except for slight varicosities. Temperature, normal. The Wassermann was negative with both antigens.

Case 7. Joseph F., age 60, carpenter. The patient has had varicose veins and ulcers of both legs for four years, with extensive varicose veins of both legs and ulcers over both shins, largest on right leg. He had extensive eczema. X-ray

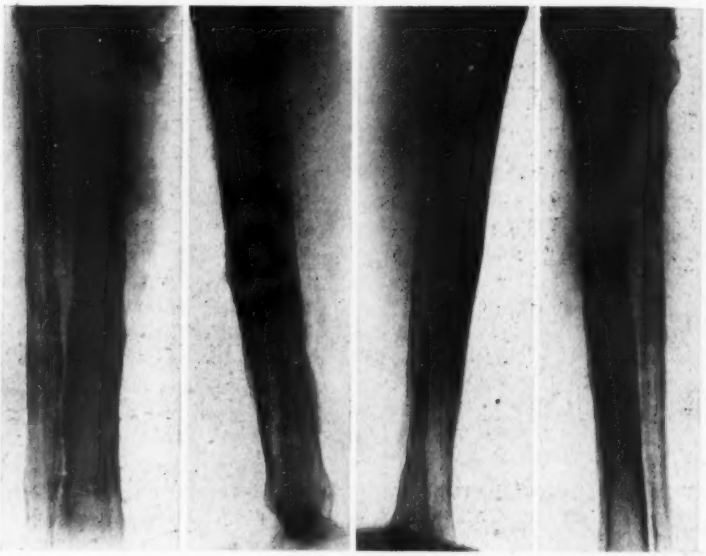


Fig. 18. At left, roentgenogram of right leg showing extensive osteitis and calcification of vessels. At right, roentgenogram of left leg showing bony changes less marked. There is no calcification of the vessels.

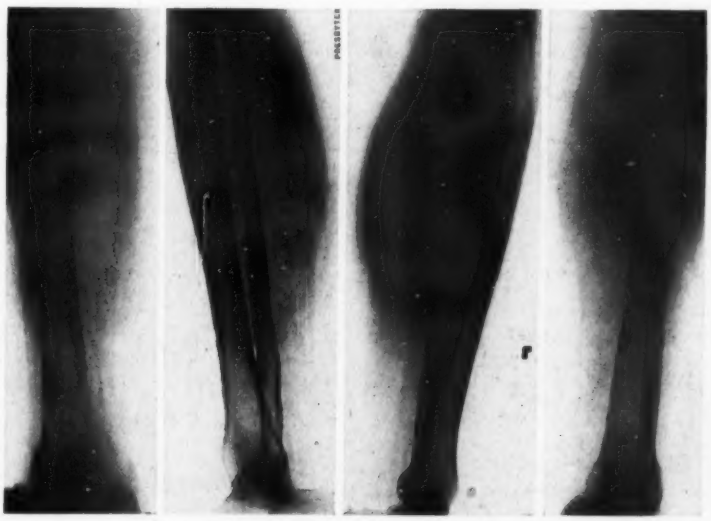


Fig. 19. Case 9. At left, roentgenogram of both bones of the right leg, showing irregular periosteitis and calcification of vessels. At right, roentgenogram of left leg, practically normal.

Fig. 20. Case 8. Varicose veins of the right anterior crural region which had been present for 17 years. At left, roentgenogram of the right leg showing marked bony changes in the fibula and the upper half of the tibia. There is pronounced vascular infiltration. At right, roentgenogram of left leg practically normal.

Fig. 21. Case 10. At left, roentgenogram of both bones of left leg showing diffuse osteitis. At right, roentgenogram of right leg showing slight periostitis of fibula.

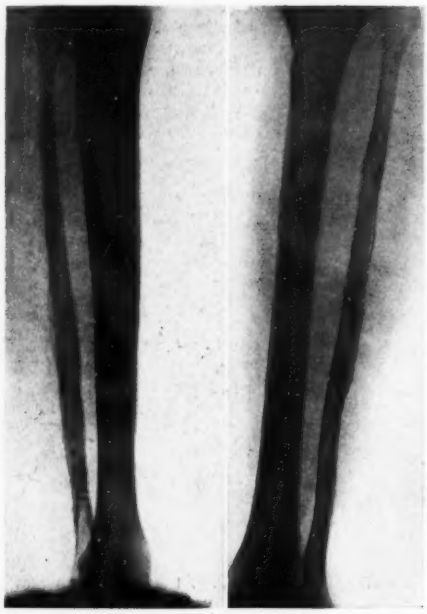


Fig. 22. Case 11. Varicose veins of both legs for many years. There is an ulcer of the left anterior crural region which has been present for 3 years. Roentgenogram of both legs showing moderate osteitis of fibula in each.

examination showed extensive periosteitis and osteomyelitis involving the interosseous space, especially in the right leg. Calcified blood vessels were clearly shown. The Wassermann was negative.

Case 8. Amelia H., age 53, housewife. The patient has had an ulcer of the anterior crural region of the right leg for 17 years. On the anterior aspect of the right leg at the junction of the middle and lower one-third was an irregular superficial ulcer 3 by 2 inches in diameter. Varicose veins of both legs were present but not marked. There were localized areas of thrombophlebitis. The leg was swollen and somewhat œdematous. The ankle was thickened and the soft parts dense and boggy. The Wassermann was negative. Urine: specific gravity, 1,030; reaction, acid; albumin, trace glucose, 3+ Microscopic examination; showed mucous leucocytes and squamous epithelium. Blood pressure: 170 to 110. Heart: no murmurs, no enlargement. X-ray examination of the right leg showed characteristic bone and vascular changes. None in left.

Case 9. Margaret M. The patient had had an ulcer of the anterior crural region of the right leg at intervals for over 20 years. At times the ulcer healed, but soon broke down again on slight trauma. Varicose veins were present. The Wassermann was negative. There is an ulcer at present about 3.5

Fig. 23

Fig. 24

Fig. 23. Case 12. Roentgenogram of left leg showing slight periosteitis of fibula and calcification of vessels. Roentgenogram of right leg normal.

Fig. 24. Case 13. Roentgenogram of left leg showing moderate osteitis of both bones. Calcification of vessels present. The opposite leg appears normal on X-ray examination.

inches in diameter; superficial. The base of the ulcer is covered with unhealthy granulation. There is œdema of the right leg. A culture from the ulcer shows bacillus mucosus capsulatus, and staphylococcus albus. Urine: there is a trace of albumin; otherwise negative. X-ray examination showed moderate periosteal thickening and roughening in the right fibula, most marked in the lower half of the bone. Also there was slight periosteitis in the right tibia. No similar changes were present in the left. The posterior tibial vessels of the right leg were partially calcified. No similar changes in left.

CASE 10. Richard S. The patient has had an ulcer of the anterior crural region of the left leg for 10 months following trauma. The patient struck his shin with a barrel hoop and several ulcers appeared, of which one failed to heal. This was about 1 inch in diameter and was located over the anterior border of the tibia. There were moderate varicosities of both legs, especially marked in the left leg. The skin of the right leg was slightly œdematous and pigmented. The Wassermann was negative. The ulcer healed under appropriate treatment. X-ray examination of the left leg showed thickening and roughening of the periosteum of both bones, diffuse throughout the entire shaft. There was no indication of osteomyelitis. Calcification of vessels. X-ray examination of the right leg showed similar changes but

Fig. 25. Case 14. Roentgenogram of left leg showing osteitis of fibula and calcification of vessels. The right leg appears normal on X-ray examination.

less marked in the bones of the right leg. There was no calcification of vessels.

CASE 11. Emma M., age 40, housewife. The patient has had varicose veins of both legs for years. She has had a superficial ulcer of the left anterior crural region for three years. The Wassermann was negative.

CASE 12. Louis M., age 57, expressman. The patient had a varicose ulcer of the left anterior crural region which had been present for 8 years. The ulcer healed at intervals but returned 7 months ago, since which time it has been growing steadily larger. The patient has an extensive ulcer over the anterior and medial crural region of left leg, 6. 5 inches long, and 5 inches wide. The ulcer was superficial. Marked varicose veins were present. The Wassermann was negative. The ulcer healed in six weeks under treatment. The right leg was normal.

CASE 13. Henry G. The patient has had varicose veins of both legs for many years. The left leg showed a pigmented scar of healed ulcer. There was chronic intermittent ulceration about the left great toe-nail associated with onychogryphosis. X-ray examination showed moderate osteitis of the bones of the left leg and marked calcification of vessels. The right leg was normal. The Wassermann was negative.

CASE 14. Anna B., age 56, cook. The patient has had varicose veins of left leg for many years. One year ago an ulcer on the anterior crural region healed after several weeks' treatment. The present ulcers have existed for three weeks. Patient has two ulcers on the left anterior crural region, one about 2 inches above internal malleolus 2 inches in diameter; the other about opposite middle of anterior border of the tibia, 1 centimeter in diameter. Both are superficial and do not extend into the subcutaneous tissue. The Wassermann was negative.

RECURRENT INTERNAL HERNIA FOLLOWING GASTRO-ENTEROSTOMY

BY ROBERT C. BRYAN, M.D., F.A.C.S., RICHMOND, VIRGINIA

MOSCHCOWITZ and Wilensky[1] recognize the possibility of internal herniation with gastro-enterostomy and to prevent such a hernia between the upper loop state that it is well to suture the afferent loop of the jejunum to the lower surface of the transverse mesocolon with about four interrupted sutures.

Herbert J. Patterson, in *Surgery of the Stomach*, 1914, further recognizes the possibility of this complication and states that:

> Several instances of internal hernia after gastro-jejunostomy have been recorded. In most of them a portion of the small intestine has slipped through the artificial aperture in the mesocolon and has become strangulated. So far as I am aware, since the adoption of the practice of suturing the edges of the mesocolon to the jejunum or stomach, no instance of this complication has been recorded.

B. A. G. Moynihan gives the following specific cases in his *Duodenal Ulcer*, second edition, 1912:

> CASE 16. Death occurred on the tenth day with symptoms pointing to intestinal obstruction. At the autopsy it was found that almost the whole of the small intestine had passed into the lesser sac through the opening made in the transverse mesocolon for the performance of the anastomosis. A similar hernia occurred in Case 24; this was more gradual in onset, but necessitated operation at a later date. Since that time it has been a routine procedure to suture the margin of the opening in the mesocolon to the line of the anastomosis in order to prevent such an accident.

F. D. M., mechanic, referred by Dr. J. F. Jones, of Richmond, Va., was brought to Grace Hospital January 9, 1918, having experienced an agonizing pain in the pit of the stomach while at work.

Upon examination the abdomen was found board-hard and diagnosis of perforated gastric or duodenal ulcer was made. Under general (ether) anæsthesia a high median incision showed a round, small, perforated ulcer of the anterior wall of the first part of the duodenum through which fluid and bubbles of gas were escaping. There was considerable fluid and flakes of lymph in the abdominal cavity; there were no adhesions about the ulcer and the area of induration extended about one inch from the perforation in every direction. The hole was pared, purse-string invaginated, sewn over, and a small tab of omentum from the gastrohepatic omentum was tacked about the hole. The wound was brought together with catgut No. 2 in layers, with silkworm gut through the skin. A stab opening was then made below the appendix and a rubber tube inserted into the pelvic cavity for drainage. The tube was removed from the stab wound in

[1] Surg., Gynec. & Obst., 1915, xxxi, 390.

Fig. 1. Hernia of the jejunum posterior to the gastrojejunostomy. At operation the intestines were simply pulled back.

three days, the patient had an uneventful convalescence and was able to leave the hospital in four weeks, eating solid food and declaring he felt in excellent health.

About a week after he left the hospital he returned stating he had acid eructations and some discomfort and pain in the stomach. The operation of gastro-enterostomy was explained to him, he decided to have it done and he was operated on at The Sheltering Arms Hospital, March 5, 1918. Under general (ether) anæsthesia and with high median incision the usual posterior gastrojejunostomy was performed. It was interesting to note that the duodenal perforation had healed well, and whitish radiations were seen under the omental tab which had been tacked at the opening, the abdominal wall being brought together in layers with catgut No. 2 and the skin with silkworm gut. The original stab wound was opened up as a gridiron, and a long chronically inflamed appendix was removed by severance and purse-string invagination. The patient had an uneventful course for 10 days, to March 15, when he suddenly developed vomiting of a stercoraceous character, which was followed March 17, by the vomiting of blood. He was now much shocked, with subnormal temperature and pulse 150. The diagnosis of hæmorrhage from the original perforation or about the gastrojejunal junction was made, and, although the patient was much weakened by his lack of nutrition and incessant vomiting, for the third time the wound was opened up (ether anæsthesia) in the same line (high median) and it was found that the small intestines had gone through behind the jejunogastric hiatus, were hanging to the left over the junction of the jejunum with the stomach, so that there was a constriction of the smaller intestines with enormous distention of the duodenum and jejunum as far as this point; the mesenteric vessels were engorged and the walls of this segment of the gut blue-gray, with small dark petechial hæmorrhages here and there. The intestines were pulled back through the opening, replaced in their right position, the peritoneum soon gaining its normal color. The contents of the jejunal loop were stroked onward. There was no evidence of inflammation about the original perforation or about the new hiatus. The appendix scar from within was clean, with no adhesions. The wound was brought together with catgut No. 2 in layers, silkworm gut through the skin. The patient returned to bed in a rather weakened state and distinctly shocked. Murphy's solution, drop method, and hypodermoclysis were instituted, and in two days his condition was again satis-

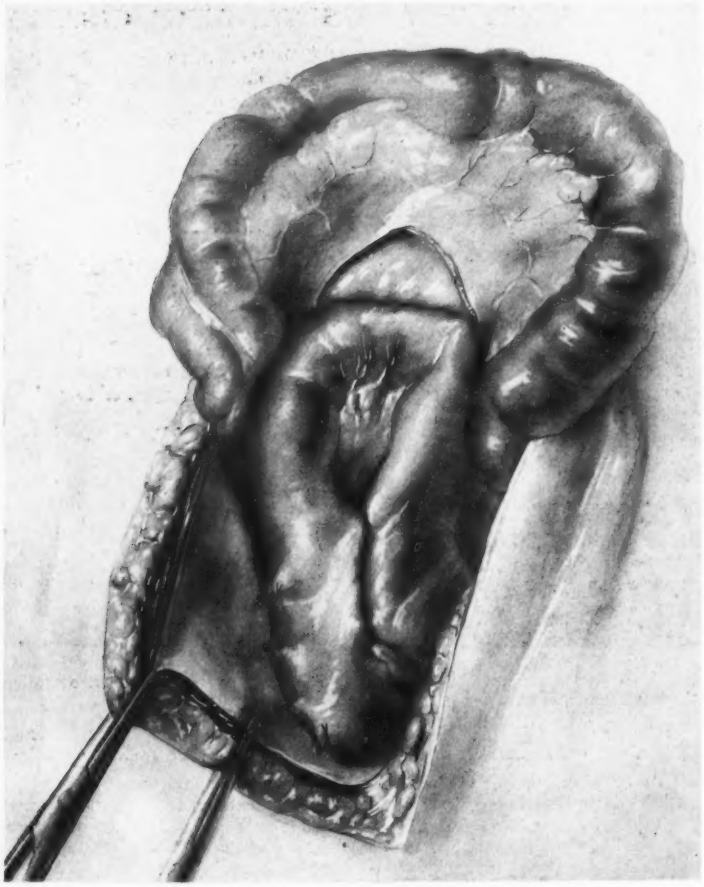


Fig. 2. Jejunojejunostomy carried out and the descending loop sewn to the abdominal peritoneum to prevent a recurrence of the hernia.

factory. Fluids and nourishment were now being given by mouth. The night of the 22d he developed again a constant and continuous regurgitant vomiting, complaining of pain in the pit of the stomach. Diagnosis: Recurring gastrojejunal hernia. On March 23, under general (ether) anæsthesia the wound was for the fourth time opened through the same high median incision by cutting the stitches and tearing through the belly wall with the finger. The intestines were found to have again gone through the same opening, there was intense constriction of the mesenteric blood vessels, large black venous hæmorrhagic spots were seen in the mesentery above the point of constriction, and here and there inflammatory areas of lymph exudate on the peritoneal coat of the intestines, so that the intestines were stuck together with many angulations. The intestines were again pulled back through the opening and replaced in their normal bed, and, to prevent a recurrence, the small intestines were sewn by several stitches of silk to the right lateral abdominal wall and an enterojejunostomy was performed so that the contents of the now much distended and apparently paralyzed jejunal loop could pour into the intestines beyond. Hypodermoclysis was carried out while the patient was on the operating table. The patient's condition continued extremely critical for several days, during which time Murphy's drop method was intermittently instituted. There was some regurgitation-vomiting following the fourth operation. All nourishment was administered by the rectum only for three days.

Fig. 3. Schematic illustrations showing direction of flow of intestinal contents.

The patient rapidly began to pick up, but developed a large bed sore over the sacrum and complained constantly of heartburn requiring alkalinization.

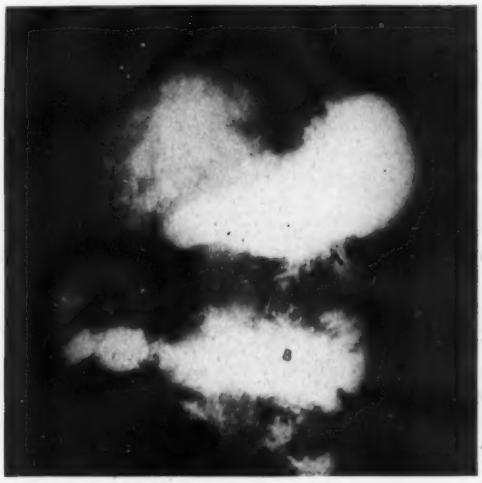


Fig. 4. F. J. M. Roentgenogram. Dr. F. M. Hodges, Richmond, November 8, 1919, twenty-one months after operation. *A*, Gastro-enterostomy; *B*, jejunojejunostomy

April 10. Patient has been on solid food for a week, is sitting up in a chair, is gaining rapidly, there is no waterbrash, there is no pain, the bowels are working well. He declares he feels better than he has for the past year.

February, 1919, the patient has been at work for several months, weighs 190 pounds, the digestion is excellent, there is no pain or discomfort, and on coughing and straining there is apparently no weakening of the high "median line of multiple incisions."

COLLOID ADENOCARCINOMA OF THE BLADDER[1]

By B. S. BARRINGER, M. D., New York
Surgeon to the Memorial Hospital

THE following case of colloid carcinoma of the bladder is unique, as far as a brief search of the literature reveals. Both Dr. Ewing and I have been unable to find the report of any tumor that resembles it.

A man of 44 years was first seen in June, 1918. He gave the history of having suffered pain in the left inguinal region for 4 years, and had noticed a growth in his lower abdomen for 2 years. This had been slowly growing larger. There was no marked frequency of urination, and no history of hæmaturia. He was a strong man and had worked up to the present time.

On physical examination I found a regular, firm suprapubic tumor extending to within 2 inches of the umbilicus. The tumor was flat to percussion, and not fixed. It could be felt per rectum. The prostate was slightly enlarged and smooth. Cystoscopy showed a tumor as large as a small orange pressing in the top of the bladder, covered with normal mucous membrane except at one spot where the mucous membrane was thrown into folds and reddened.

Because we did not know the nature of this tumor and because of the marked susceptibility of some tumors to the "radium pack," a pack of 1131 millicuries for 16 hours (18,096 millicurie hours) was placed over the suprapubic mass and the growth watched for the following three months. Radium used in this way is heavily screened with lead and wood and placed some inches away from the skin. This method of radiation is quite different from that usually used, e.g., in carcinoma of the bladder where the radium is placed directly upon the tumor.

There were two practical reasons for treating the tumor with radium. First, by its use the tumor might be reduced in size and so be made more easily operable; and second, if operation were necessary the effect of the radium might be to reduce the malignancy of the tumor cells and so reduce the chance of implantation of active tumor cells at the time of operation. This sounds perhaps chimerical, but it is, I believe, a decidedly practical consideration. For instance, in teratoma of the testicle, if the growth has gone beyond the testicle, our present viewpoint is that radium in the form of a radium pack is quite as, if not more, important than operation. In this case, however, the radium apparently had no effect. During the three months the tumor grew slightly larger. I then operated upon him, and found a very large tumor growing from the bladder, but attached to no other abdominal organ.

It was manifestly malignant with soft gelatinous spots surrounded by harder fibrous areas. The tumor was cut off from the bladder, the lower half of which was left apparently tumor free. This was sutured up tight with a double row of plain catgut sutures and the abdominal wall was sutured, a small drain being left going down to the bladder. A retained catheter was put into the urethra. This the patient passed out the night following operation. He has urinated without trouble by urethra ever since. Three months later I saw by cystoscopy some irregular tumors around the bladder neck which I took to be implantations. The top of the bladder showed no tumor and not even the scar of the incision. The bladder neck was treated by a strong dose of radium. I saw him last in May, of this year, 8 months after his operation. He had a slight radium burn of the bladder neck, slightly increased frequency of urination, and no tumor that could be seen or felt. He has been working for 6 months. Dr. Ewing's pathological report was:

"Tumor of bladder, teratoid tumor.

"The tumor is a nearly spherical mass, 11 by 18 by 7½ centimeters. It is said to have been within the wall of the bladder, lying on the upper and posterior surface, leaving the mucosa free while adherent to the peritoneum which covers a considerable portion of the surface. The surface presents numerous soft protruding cystic nodules, which also compose most of the mass of the growth. On section the tumor is composed of a central core of dense fibrous tissue radiating out to periphery and inclosing cysts of various sizes filled with firm gelatinous material. This material becomes more abundant toward the periphery. There is a peculiar slit-like opening in the central core.

"Microscopic sections show the structure of a cystic adenocarcinoma with advanced gelatinous degeneration which has destroyed most of the tumor cells. The stroma is of dense hyaline acellular fibromuscular tissue, in which there are numerous calcific foci. The general appearance is that of the intestinal gelatinous carcinomata, but the cells are flat or cuboidal, and not cylindrical.

"The tumor probably belongs to the group of teratoid tumors of the bladder, but its exact origin is not clear. Possibly it arises from a misplaced remnant of embryonal intestinal canal."

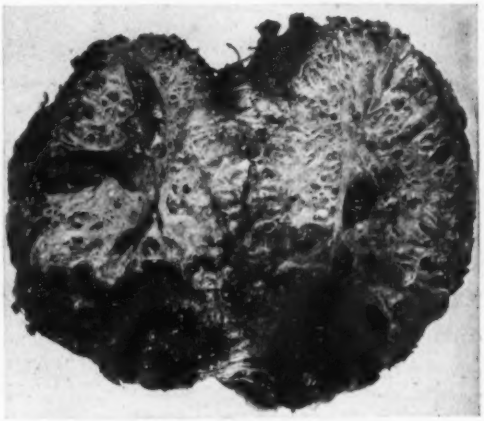
My thanks are also due to Dr. Ewing for the following comments on the tumor:

"I do not find any compelling reason for assuming an origin from remnants of allantois or cloaca in the cases of mucoid carcinoma of the bladder reported by Chute and Crosbie and by Mandelbaum, or in the cases cited by them from the literature. I have looked up the original reports of these cases and find that all the tumors were located in and often confined

[1]From the service of the Memorial Hospital.

chiefly to the vesical mucosa. The development of mucous carcinoma from the epithelium of the vesical mucosa, either on the basis of cystitis cystica in which the follicles regularly produce mucus, or from the mucous glands of the trigone, has been fully traced by Stoerk. There is no doubt that mucous carcinoma of the bladder occasionally arises in this way as does the usual type of carcinoma without mucous changes. In Haake's case there were extensive mucous changes in a polyoid tumor attached to the mucosa by a long pedicle.

"Your case, however, appears to be quite different from all the cases cited above in that it was chiefly extravesicular, being merely attached to the wall of the bladder and invading it only slightly, and unaccompanied by any broad invasion of involvement of the mucosa. For such a tumor it seems necessary to assume an origin entirely apart from the structures of the mucosa, and remnants of the allantois or cloaca present themselves as possible sources. Since your tumor lay near the apex of the bladder and since the allantoic duct as Piersol points out forms the upper part of the bladder, the allantoic duct seems the most probable origin. I have been unable to find any reference to tumors of the adult rising from allantoic epithelium, and know nothing about the probable structure of such tumors if they exist. Your tumor has a very peculiar gross structure. It presented a hard fibrous core about 3 to 4 centimeters wide in which were slits and crevices containing only mucus, while surrounding this core on all sides were more recent and more cellular portions containing alveoli of adenocarcinoma and growing cells with much mucus in alveoli and stroma. Such a gross



Colloid adenocarcinoma of the bladder. The tumor has been split open.

structure could hardly have been produced from any tissues originally within the bladder mucosa. Therefore, an origin from some extravesicular tissue rest appears highly probable, and the allantoid ducts seems to be the most natural source of such a tissue rest. This origin can only be regarded as an assumption.

"I have been unable to find any tumor like yours in the literature of bladder growths, but there is a series of very firm gelatinous carcinomata of the pelvis to which your case may belong."

DEPARTMENT OF TECHNIQUE

THE TECHNIQUE OF INGUINAL HERNIOTOMY

With Special Reference to the Closure of the Internal Ring[1]

By E. P. QUAIN, M.D., F.A.C.S., Bismarck, North Dakota
Formerly Lieutenant Colonel, M.C., U.S.A.

THE object of this paper is to call attention to a few anatomic and technical points which are of special importance in our efforts to obtain one hundred per cent permanent cures through the radical operation for indirect inguinal hernia. Although the technique which will be described, and the reasons for its adoption, cannot be claimed to be original except in some of the details, the ensemble of the proceedings is unquestionably of quite recent origin.

During my service in the army in the past year and a half I have had the opportunity of having under surgical treatment and observation several hundred cases of indirect inguinal hernia. In the spring months of 1918 at the cantonment hospital, where I was then on duty, our daily list of herniotomies varied between 10 and 25. It was, therefore, natural that this subject required and was given somewhat intensive attention in our surgical service. As a result of our studies and experiences we arrived at rather definite conclusions as to the technique most likely to offer permanency of cure. Most of the hernias had not been subjected to previous operation and gave us therefore the primary opportunity of offering a cure through operation. But there were presented to us a fair number of cases in which recurrence had taken place after one or more earlier operations. These were of special interest because they gave us the opportunity of trying to find out why recurrence had taken place.

Associated with me in the service were a number of surgeons, some of greater and some of lesser experience in the treatment of hernia. Discussions with these surgeons, and the opportunity of familiarizing myself both with their previous results and with their actual steps of technique helped to throw light on the subject. Without going further into detail it may be stated that there were found to be four general causes for failure in operation: (1) leaving the stump of the sac too long; (2) failure to close properly the internal abdominal ring; (3) leaving too much unnecessary tissue attached to the cord within the internal ring; (4) letting the patient resume work too early after operation for large hernia.

It is assumed that all those who attempt any hernia operation as a procedure of choice, are already familiar with the anatomy of the structures involved. The only structure requiring review for the present purpose is that of the spermatic cord. The spermatic cord is composed of several elements. Among these, the vas deferens and the spermatic artery and veins, all passing through the internal abdominal ring, are the most important. A continuation of the transversalis fascia lies in front of the vas and vessels and becomes a sheath for both just outside the ring. A loose areolar tissue with fat appears under the transversalis fibers. The cremaster muscle forms a covering over the cord, but is, from a surgical point of view, an element of the cord. The ilio-inguinal nerve passes obliquely over the cremaster, and the genital branch of the genitocrural nerve escapes through the internal abdominal ring. When an indirect hernia exists there is in addition the hernial sac incorporated with the cord and within the prolongated transversalis fascia.

The cremaster muscle has its origin from the outer part of Poupart's ligament, including that sector of this ligament which lies nearest the internal ring. This is the first of the cord elements which must be identified and properly disposed of in the operation, after the inguinal canal has been laid open. The fibers attached opposite the internal ring should be loosened from Poupart's ligament so as to allow close contact between the lower margin of the internal oblique muscle and Poupart's ligament in the closure of the ring later on. If the cremaster is very heavy it will cause the cord to remain too

[1] Read at North Dakota State Medical Association, Grand Forks, June 25 1919

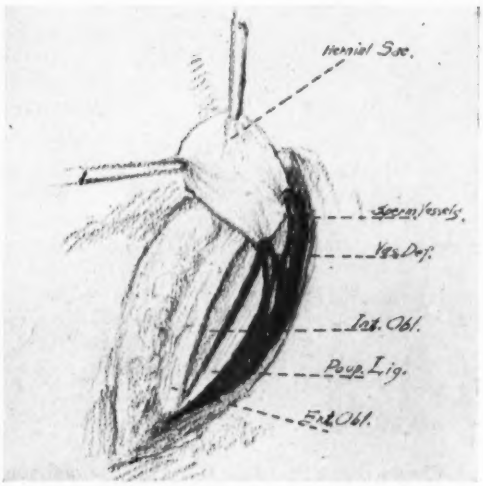


Fig. 1. Showing the "triangle" formed by vas deferens, spermatic vessels and base of hernial sac.

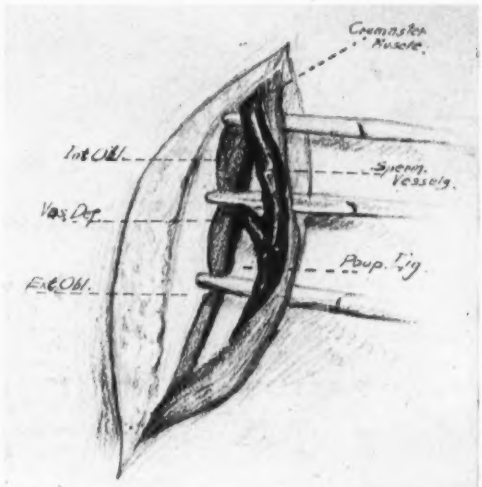


Fig. 2. Two forceps placed between vas deferens and spermatic vessels and clamped to margin of external oblique aponeurosis. A third forceps clamped below vas.

voluminous and to occupy too much space under the fascia of the external oblique at the completion of the operation. In that case a part or all of the cremaster fibers should be cut across as near their origin on Poupart's ligament as possible. The cut ends of the fibers, assembled and held by a forceps, should be lifted and dissected loose from the rest of the cord. The forceps holding the muscle are laid aside until the closure of the external oblique is completed. Then the forceps with the cremaster is pulled up over the external oblique aponeurosis where the muscle is sutured into place in such a way that a slight lifting action is seen to be exerted on the structures of the scrotum.

After the cremaster had been disposed of, the hernial sac is identified and dissected free. At its base it will be found to lie above and between the vas deferens and the spermatic artery. When the sac is markedly adherent, or prolonged along the cord, no time should be wasted in trying to find its apex by dissection outside the sac. It is better to open the sac at once, insert a finger and dissect it free while the finger is used as a tractor. A better hold on the slippery peritoneum is obtained by winding a layer or two of gauze over the finger. Hernial contents, if present, are replaced, and the base of the sac is loosened in its entire circumference. It is the writer's opinion that if there is any one step of more importance than other steps in a herniotomy, it is the thoroughness of liberating the sac from its surrounding structures *within* the internal abdominal ring. In the first place, thorough and high freeing of the sac alone will permit the stump to retract into the abdomen and, secondly, when the sac is radically liberated, the margin of the internal ring also will have been freed from all the fibrous and areolar tissue which otherwise will interfere with proper closure of the ring.

In most old hernias there is found a scar-like area or constriction on the peritoneum within the sac. This fibrous area is adherent firmly to the neighboring parts of the cord. If this constriction should be considered the true neck of the sac and ligation made at this point, the hernia is not likely to be cured. Further examination will reveal the fact that there is a segment of sac extending from the white scar up to the niveau of the abdominal peritoneum, which segment may be from one-fourth to one full inch in length. This is not all. This fibrous area is firmly bound to the cord *outside* the internal ring, and it cannot therefore retract to a point high enough to permit the internal oblique to contact properly with Poupart's ligament in the closure of the internal ring. A stump of the hernial sac remains within the internal ring. The hernia is not cured, it is merely abbreviated. A wedge of peritoneum extends through the abdominal wall at the conclusion of the operation.

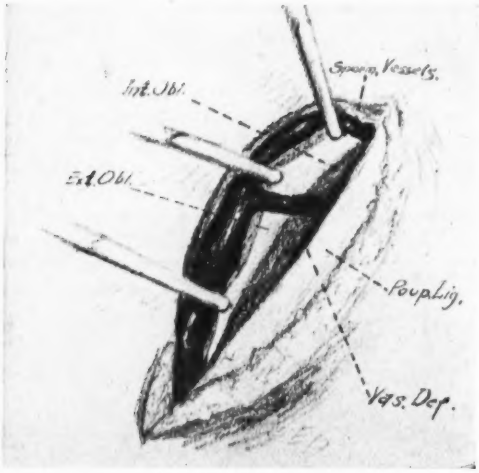


Fig. 3. The three forceps held up to expose internal oblique and conjoined tendon for suturing.

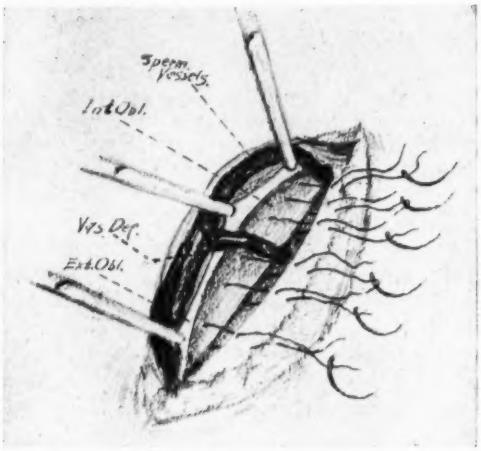


Fig. 4. Three sutures placed between vas and vessels, and three into conjoined tendon below vas.

Faulty suturing of muscle to Poupart's ligament acts as an additional invitation for a subsequent increase of this peritoneal pouch. It is improper to term reappearing pain and bulging in the inguinal canal, after this sort of technique, a *recurrence*. It is a *persistence* of the original hernia.

When the sac is properly liberated from the internal oblique above and from the vas and spermatic vessels below, and traction is made on the sac upward, it will be seen that the vas comes out at the inner or mesial border of the opening and the vessels at the outer margin. It is seen further that the vas comes in an upward direction from the region of the pelvis while the blood vessels come from above. A triangle is formed by the peritoneum above, the vas mesially and the blood vessels externally (Fig. 1). The dissection and preparation of the sac should not be considered completed until this triangle is clearly identified and seen. While traction is exerted on the peritoneal tube, transfixion and ligation are made at the highest point possible to reach with needle and suture. If the sac is broad a puckering suture is needed. After the sac is cut away, the stump retracts promptly and disappears through the opening.

The vas and the spermatic vessels are but loosely connected in the internal ring. They approach one another and become more firmly associated about one-half inch outside the ring. If the hernial opening, i.e., the internal ring, is so large that the index finger can be thrust readily through it, or larger, then the tight closure of the ring is made more certain if the vas is separated entirely from the spermatic vessels and the sutures passed between them. The larger the opening, the stronger is the indication for this procedure. It is necessary always to leave enough opening to permit the two structures to escape from the abdomen. By allowing the vas to come out at one place and the vessels at another, this necessary opening is divided into two openings, each of which need be only half as large as if the two openings were one. This reduces the remaining weakness in the entire technique of herniotomy, practically by half, for the probability of recurrence is in direct proportion to the size of the remaining opening. When vas and vessels are separated from each other and separated from all unnecessary fat and fibrous tissue, they each require a very small opening, say about one-eighth of an inch in diameter. There is in reality but slight disturbance made to either vas or vessels in this technique for the hernial sac and contents have already pushed these structures away from one another, so that the vas remains close to the deep epigastric artery on the inner side, and the spermatic vessels close against the junction of internal oblique and Poupart's ligament on the outer side of the internal ring.

Two artery forceps are pushed between vas and vessels and clamped over the margin of the external oblique aponeurosis, so as to hold the two structures separated and out of the way for the placing of the sutures. Another forceps is

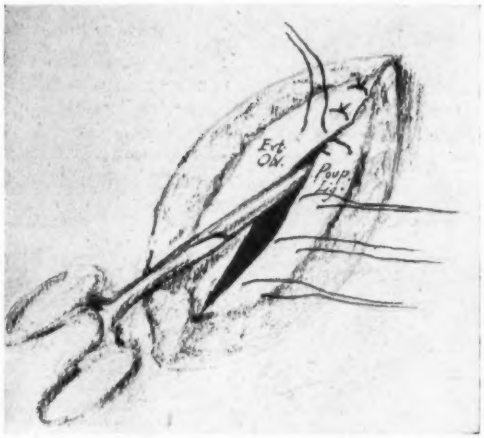


Fig. 5. Showing closure of inguinal canal. Forceps used to hold cord in proper position while internal ring is being closed.

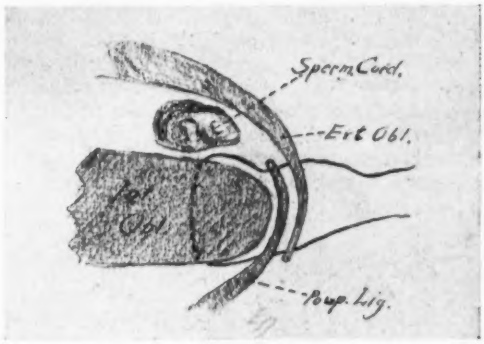


Fig. 6. Cross section of inguinal canal to show approximation of internal oblique to Poupart's ligament and overlapping of external oblique.

placed similarly under the cord, below the vas (Figs. 2 and 3).

When the dissection described is completed properly, it will be found that the lower margin of the internal oblique at this point presents a broad fleshy surface. The transversalis muscle lying under the internal oblique increases the muscular surface now ready to be sutured to Poupart's ligament. No tissue must remain between the muscles and Poupart's ligament. The approximation must be direct and firm, but without undue tension. Three or four interrupted chromic catgut sutures are placed between vas and vessels (Fig. 4). In a large opening a greater number will be required. The sutures are introduced from outside and near the margin of Poupart's ligament. The full thickness of the muscles (internal oblique and transversalis) is included in the suture taken from without inward, but the width of the bite need not exceed one-third of an inch. The needle is repassed through Poupart's ligament well toward its lower margin. Care must be exercised that the sutures are placed at points directly opposing one another on the two surfaces about to be united. When the catgut is tied outside the ligament the internal oblique will thus have the most even and the broadest application possible to Poupart's ligament (Figs. 5 and 6). The internal ring is closed. In a similar manner two or three additional sutures are placed below the vas to approximate the conjoined tendon to Poupart's ligament. No tissue should intervene between these structures, if uniform and permanent adhesions are to be expected. The loose tissues overlying the margin of the conjoined tendon must be cleaned away until this aponeurosis is bare. The uppermost suture below the vas should be placed high enough so that the vas is held somewhat firmly against Poupart's ligament. Owing to the great rigidity of the vas, there is but slight danger of harmful impingement upon it or upon its accompanying artery, by the elastic muscle fibers. The spermatic vessels are also packed into a very small compartment by the stitch nearest them, but more regard must be given to possible constriction of veins here than in the case of the opening for the vas. The spermatic vessels will rest in a muscular foramen of considerable length and the re-formation of an internal ring at this point is scarcely within the range of possibility, after proper healing.

This method of closing the internal ring in a painstaking and accurate manner places a firm and lasting barrier at the very point where the indirect inguinal hernia always begins its protrusion through the abdominal wall; namely, between the vas deferens and the spermatic artery. The method was first described by Dr. Torek[1] of New York seven years ago. Herniæ in which the internal ring is narrower than the size roughly indicated above, do not require a separation of vas and vessels provided the other steps of radical preparation of anatomic structures have been followed out.

The sutures should all be placed before tying any of them. Tying should begin above and proceed to the one nearest the pubes. The catgut is usually tied outside Poupart's ligament, but not

[1] Med. Rec. 1912, June 22.

cut. The ends are rethreaded on needles which are made to pass through the margin of the external oblique aponeurosis above, after removing the three forceps which have held the cord out of the way up to this time. A second tying over this margin completes the closure of the inguinal canal. A smoother closure is obtained if the catgut is not tied at all until after the ends have been passed through the external aponeurosis so as to cause it to lap over Poupart's ligament with one single tying, but this method is a little more difficult of execution, and requires more assistance.

Using the same suture for the double closure reduces to a minimum the amount of catgut to be absorbed. Also, any possible oozing of blood or lymph in the depth of the wound finds a ready route for drainage along the catgut, into the deep superficial tissues where it is more easily absorbed.

Work requiring severe muscular exertion should not be undertaken for several months after a large hernia. Every patient should be taught that his groin will remain "weak" for two to four months after a herniotomy.

Clean dissection, careful control of all bleeding, gentle handling of tissues, and asepsis, are essentials if hundred per cent cure be the standard.

AN IMPROVED WIRE SPLINT FOR CONGENITAL CLUB-FEET

By A. J. DALTON, M.D., St. Joseph, Illinois

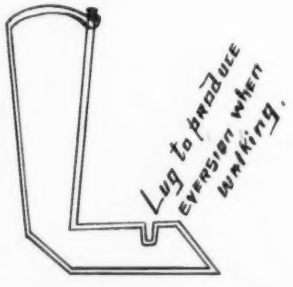
IN 1915[1] I presented a wire splint for the correction of congenital talipes equinovarus. This splint was especially applicable to children before the walking period. Herewith I am presenting a similar splint with the addition of a lug on the inner and anterior border of the foot piece of the splint by which the foot is everted and flexed whenever the child bears weight upon the foot; hence this splint is applicable to the walking period.

In my previous article I stated that the plantar part of the splint could and should be bent to a degree to overcome the equinus and also the varus, this change in angle being made gradually, which will minimize the amount of pain experienced by the child. This change in angle can be made when the splint is taken off at the different dressing periods and these periods usually extend over two or three weeks. Unless the skin is thoroughly bathed in alcohol at this time, there is likely to be some irritation from the adhesive.

In strapping on this splint the strap which holds the heel in place should be an inch to an inch and a half in width and extend up just above the calf of the leg. The foot of the child must be strapped firmly to the foot of the splint before pulling the leg portion of the splint in position, being careful to avoid constriction.

This splint has been so satisfactory in my hands during the past four years, having so many advantages over the plaster cast treatment that I wish to emphasize that, in cases where the deformity has not been of too long standing, all deformity can be overcorrected and maintained until the weakened tendons regain their normal tonicity without injury to the skin or any of the unpleasant results experienced with casts.

[1] Surg., Gynec. & Obst., 1915, xx, 233.



This improvement is applicable in cases walking.

METHYLENE BLUE IN THE DIAGNOSIS OF ACUTE PERFORATING GASTRIC AND DUODENAL ULCERS

By HILLIER L. BAKER, M.D., Chicago

FOLLOWING the preliminary report[1] of the use of methylene blue in the diagnosis of acute perforating gastric and duodenal ulcers, it has been possible to make further observations, and the expectations arising from the use of that stain in perforation have been justified.

The clinical diagnosis of perforation because of the variability of the symptoms is often difficult and at times an exact diagnosis is impossible. Where perforation seems highly probable, the diagnosis can be positively made on opening an abdomen and finding the leaked-out greenish-blue fluid, previously given by mouth. The perforation can then be readily found and repair effected. In other cases where a plastic fibrinous peritonitis without free fluid in the peritoneal cavity is present the use of coloring matter is particularly helpful in disclosing the site of the perforation.

The following examples illustrate:

Case 1. J. B., a white male, age 43, a teamster by occupation, was admitted to the Cook County Hospital, July 19, 1918, on the service of Dr. Andrews. The examining room diagnosis was acute appendicitis. The patient stated that he had been perfectly well until 4 p. m., July 18, 1918. While at work he was seized with a sharp, piercing pain in the abdomen which doubled him up. He had vomited since the onset of the pain. The vomitus contained food but no blood. The pain had been continuous since onset and was localized to the right side at first, but since then it has become generalized. Patient denied previous ulcer history.

Physical examination revealed a white male of apparent age acutely ill. The abdomen was rigid, particularly on the right side. Tenderness was present over the entire abdomen but most marked in the upper right quadrant and also over McBurney's point. The patient's temperature was 101.2°, pulse 106, and respiration 36 per minute. The white blood count was 13,000. Examination of the urine gave negative result. Examination of the heart, lungs, and extremities was negative. A diagnosis of probable ruptured gastric ulcer was made and the patient was given by mouth 3 grains of methylene blue dissolved in an ounce of water.

At operation a mid-line incision was made. On opening the peritoneal cavity an acute generalized peritonitis was found with free fluid which was stained blue. In the region of the pylorus a large hard indurated ulcer was found, the center of which was perforated and stained blue. Repair of the perforation was effected and the abdomen closed with drainage. The patient made an uneventful recovery and was discharged from the hospital August 19, 1918.

Case 2. W. S., a white male, age 35, a cook by occupation, was admitted to Cook County Hospital, April 4, 1917, on the service of Dr. Speed. The examining room diagnosis was appendicitis. The patient stated that 5 days before admission he had slight cramps in the abdomen which disappeared on taking large doses of castor oil. Twenty-four hours before admission he was suddenly seized with sharp, agonizing pain in the abdomen. The pain was continuous for 5 hours, when it was somewhat relieved by an enema and by inducing vomiting. The vomitus was a bitter, green, thick fluid. Since then he has had continuous pain in the region of the umbilicus. No previous ulcer history could be elicited.

Physical examination revealed a white male of apparent age who did not look acutely ill. There was a slight rigidity over the entire abdomen more marked on the right side. Diffuse tenderness was present most marked on the right side in the region of the umbilicus. There was a slight dullness over the right flank. The patient's temperature was 99.8°, pulse 100, and respiration 22 per minute. The white blood count was 19,900. Examination of urine, negative; of heart, lungs and extremities, negative.

A tentative diagnosis of acute appendicitis was made but perforated gastric ulcer was strongly considered.

One-half hour before operation the patient was given by mouth 3 grains of methylene blue dissolved in an ounce of water.

At operation it was thought advisable to first examine the appendix. This was done. A right rectus incision was made. The appendix was found to be superficially injected but not sufficiently to account for the symptoms. The incision was extended upward. Fibrinous adhesions were found about the liver and gall-bladder with a generalized seropurulent peritonitis and injection of the parietal and visceral peritoneum. On the surface of the stomach near the pylorus a bluish stain was seen.

A perforation about the size of a match head was found. The area surrounding the perforation was hard. The perforation was covered with fibrin so that it was indistinguishable except for the blue discoloration. The perforation was repaired and the abdomen was closed with drainage. Patient made an uneventful recovery and was discharged May 16, 1917.

Case 3. W. C., a white male, age 58, had been in the County Hospital on the service of Dr. Williamson, on treatment for duodenal ulcer. On May 8, 1917, while in the ward he was seized with severe pain in the abdomen. He vomited blood and was transferred to the surgical service of Dr. Andrews, with a diagnosis of ruptured duodenal ulcer.

Physical examination revealed an old man who was apparently in acute pain. The patient looked very pale and was quite weak. The abdomen was scaphoid, very tense, and with almost "board-like" rigidity on the right side. Tenderness diffuse over abdomen. The patient's temperature was 97.6°, pulse 102, and respiration 32 per minute. The skin was pale, cold and clammy. Examination of the heart, lungs and extremities, was negative.

Before operation the patient was given by mouth 3 grains of methylene blue dissolved in a half ounce of water. Operation by Dr. Meyers. A mid-line incision was made and on opening abdomen a bluish green fluid was found. A blue fluid was seen coming from the perforation in the upper anterior part of the first portion of the duodenum. The edges of the perforation were stained a deep blue. An old healed ulcer scar was found near the perforation. The

[1] Published in Surg., Gynec. & Obst., 1917, xxv, 695.

perforation was repaired with interrupted catgut sutures. The abdomen was closed with drainage. The patient made an uneventful recovery and was discharged June 7, 1917.

CASE 4. W. H. M., a white male, age 45, was admitted to the Englewood Hospital, with a diagnosis of perforated gastric ulcer. The patient gave a history of gastric distress and pain in the epigastrium of several years' standing. On April 17, 1918, he had undertaken a fasting cure and had lived entirely on water for 8 days. He continued to go to his office every day as usual. On April 26, at twelve o'clock he was suddenly seized with an agonizing pain in the abdomen. The pain was localized about the umbilicus and was so severe that he sought medical advice and he was sent to the hospital for surgical treatment, where a diagnosis of ruptured gastric ulcer was made.

Physical examination revealed a man of apparent age acutely ill. The abdominal wall was rigid. Extreme tenderness was present over the entire abdomen but was most marked in the upper right quadrant. There was no dullness in the flanks. Rectal examination negative. Examination of the urine was negative: of the heart, lungs, and extremities, negative. Temperature 96.8°, pulse 90, and respirations 22 per minute. Before operation the patient was given by mouth 3 grains of methylene blue dissolved in an ounce of water.

Operation by Dr. Weatherford and Mc Quarrie.

On opening the abdomen by a mid-line incision the blue stain was in evidence. Traced up about two and one-half inches it exposed a perforation of an ulcer on the anterior wall of the stomach, one and one-half inches above the pylorus. The ulcer was clearly outlined by deep stain of methylene blue. The edges of ulcer were indurated; the floor of ulcer was very thin throughout its extent. The ulcer was repaired. The abdomen was closed in the usual way, with drainage. The patient made an uneventful recovery and was discharged from the hospital, May 10, 1918.

In all, ten cases have been observed where methylene blue has been used. As pointed out in the previous report, the use of an inert coloring matter has several features of practical value. The chief among these are: the ease and rapidity with which the diagnosis and site of perforation can be determined with minimal shock attendant on the handling of the viscera. The more extended use has shown that methylene blue is particularly helpful, by confirming the diagnosis of perforation, when the abdomen is opened, and by staining the edges of the ulcer, thus readily exposing the site of the perforation.

While it is undoubtedly true that the surgeon can often diagnose perforation by the presence of gastric fluid in the peritonal cavity, any method devoid of danger which will make diagnosis more certain should be used.

NEW WIGHT–HARLOE EMPYEMA SHIELD AND CLOSED METHOD OF APPLYING IT

BY J. SHERMAN WIGHT, M.D., AND RALPH HARLOE, M.D., BROOKLYN, NEW YORK
From the Research Department of the Long Island College Hospital

THE shield was designed for the closed method of operating for empyema. It consists of a rubber disc 3 inches in diameter, the concave surface of which comes in contact with the chest. The disc has a periphery with a sharp edge and a stem in the center about half an inch long which is perforated to receive the drainage tube. Figure 1 shows the disc with drainage tube presenting at upper surface. Figure 2 shows the plain edge and thickness of the disc with drainage tube inserted. Figures 3 and 4 show the chest penetrated by the drainage tube and the disc in position.

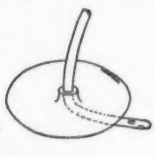


Fig. 1.

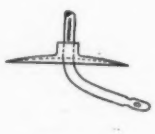


Fig. 2.

Fig. 3.

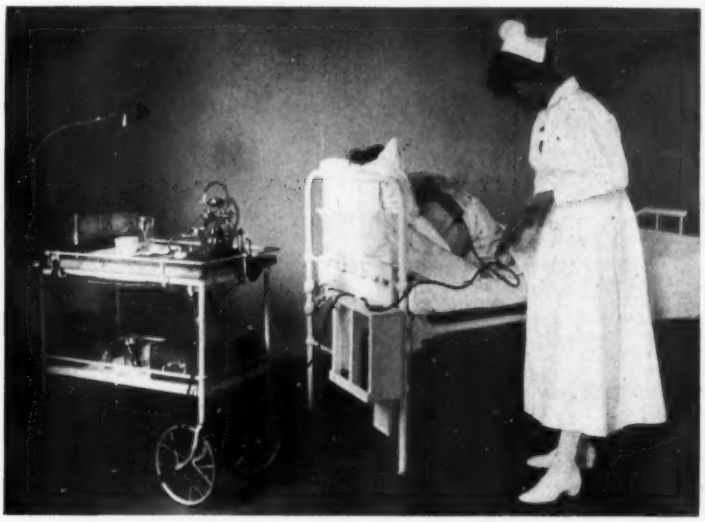


Fig. 4. Author's bedside empyema operating unit.

Closed method of operating. Under local anæsthesia a small incision is made through the skin at the eighth interspace in the posterior axillary line. A trocar and cannula are inserted, the trocar withdrawn and a drainage tube which just fits the cannula is passed through it and clamped far enough beyond the cannula so that it can be drawn up on the tube and out of the chest. Another clamp is placed on the tube close to the chest to retain the fluid while the first clamp is removed and the cannula drawn off the tube. Rubber paste is applied to the concave surface of the shield and as well to the chest wall.

The shield is passed over the tube, another clamp placed beyond it on the tube and the clamp next to the chest removed so that the shield can be brought in close contact with the chest wall and held firmly in position by broad strips of adhesive plaster pulled firmly around the chest. A pad with a hole in the center is passed over the tube and strapped firmly on top of the shield. The patient then sits up and is ready to have the fluid withdrawn by negative pressure and the cavity irrigated with Dakin's solution. The tube is connected to a suction bottle in which negative pressure is continuously maintained by electrical suction (Fig. 4).

RUPTURE OF THE UTERUS WITH PERITONEAL ENCYSTMENT

By STUART B. BLAKELY, M.D., Binghamton, New York

THE interesting features of the case reported below are: the numerous attempts to produce abortion; a traumatic rupture of the uterus with extrusion of a four months' fœtus into the general peritoneal cavity followed by general peritonitis; recovery from the peritoneal infection, healing of the uterine tear, encysting of fœtus, formation of vaginal fistula; removal of a large portion of the fœtal skeleton with indistinguishable soft parts five months later through the vagina; ultimate recovery.

Mrs. P., age 23; gravida-II. Previous history negative. Last menstruation began September 11, 1918. During the week of December 11 she herself inserted a catheter with stylet into the cervix four times without result. On January 9, 1919, she again inserted a catheter into the cervix, leaving over night, followed by a slight bloody flow without pain. This procedure was repeated the following day with like result. On January 12, the "bag of waters" was

Foetal skeleton removed through sinus opening.

broken by the passage of some instrument through the cervix. This was followed by bloody watery flow, but without pain.

On January 13, under ether some sort of operation was done through the vagina. On recovery from the anæsthetic she felt terrific abdominal pain and flowed profusely. The pain and flow persisted all that day; the patient grew rapidly worse, and the next morning she was transferred to the hospital.

On admission she complained of severe abdominal pain, had a profuse bloody discharge, and presented a temperature of 101°, pulse of 110, a hard distended tender abdomen, vomiting, retention of urine—all the evidence of a severe spreading peritonitis. In view of her extremely serious condition no vaginal or intra-uterine examination or instrumentation was done. Treatment was symptomatic and by antistreptococcic serum. She was desperately ill for one week. External examination then showed a hard tender mass filling the lower abdomen to the level of the umbilicus; by vagina the pelvis was felt to be filled with the same type of induration with no landmarks distinguishable above the cervix. The greatest pain and tenderness persisted on the right side. On January 28, the patient developed a moderately severe left femoral thrombosis, and a sudden profuse, foul, greenish-yellow vaginal discharge. At the end of four weeks the temperature and pulse had become normal, and her condition steadily improved. When discharged on March 8, the abdominal induration had receded to the lower right quadrant; by vagina was felt fixation of the uterus by diffuse pelvic induration with a tender mass in the right pelvis and a retrocervical sinus from which drained a moderate amount of pus. The diagnosis was pelvic abscess with good vaginal drainage.

One month later the vaginal discharge still persisted. Physical findings were practically unchanged, but through the vaginal sinus opening was felt a hard, rough edge that on removal proved to be a portion of fœtal skull. Roentgenogram of the pelvis was negative. However, from responsible sources the information was obtained that no portion of the fœtus had ever been removed. In view of the fact that the patient had had, probably, a streptococcic peritonitis and that her condition was good in every respect, it was deemed best to delay the removal of the fœtus. The patient agreed to return about every two weeks routinely. She had normal menstruation in April and May.

On June 20, 1919, under ether anæsthesia the sinus opening posterior to the cervix was widened, and by means of finger and spongeholder the fœtal skeleton—see illustration—was removed with considerable débris containing bony spicules. The cavity in which it was contained was thick walled with smooth interior lining. All parts could be reached by the finger, and felt clean. Convalescence was without incident and the patient left the hospital on the fifth day.

At present the fixation of the uterus persists, the indurated mass in the right pelvis is much smaller, and a slight purulent discharge continues from the sinus which is now about 2 inches in depth. Nothing abnormal can be felt by abdomen. Her general condition is good; she complains only of occasional pain in the right lower abdomen.

The writer is indebted to Dr. U. S. Kann for the excellent arrangement and roentgenogram of the skeleton.

AMERICAN COLLEGE OF SURGEONS

ANNUAL MEETING HELD IN NEW YORK CITY, OCTOBER 20–24, 1919

PRESIDENTIAL ADDRESS[1]

BY WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

THE American College of Surgeons is beginning its seventh year under most inspiring circumstances. More than three-fourths of the Fellows of the Association have been in their country's service and have returned to their work with renewed vigor and enthusiasm. In spite of the war years, the College has made progress along all lines. The Clinical Congress of Surgeons of North America has been taken over by the American College of Surgeons. In the future the educational, scientific, and moral standards of the American College of Surgeons will be maintained, and only its members and invited guests will be welcomed to the clinical meetings.

Standardization of hospitals has made great progress under the able leadership of the Director of Education, Dr. John G. Bowman. As the result of the efforts of the College, the great majority of hospitals in America of more than 100 beds will institute the restricted staff, and install the laboratory facilities and record systems which the American College of Surgeons believes to be essential.

It is the desire of the Founders of the American College of Surgeons that the association shall be democratic, and that its membership shall be open to all those men of sterling character, ability, and training in general surgery and in the various surgical specialties, who are within the limits of North America. For, when all is said and done, the College stands for service to all the people, and unless a sufficient number of men of high ideals and professional qualifications is eventually secured, the organization will have failed to live up to its great opportunities.

The exact number of men required to perform the duties of caring for the various serious surgical ills of the 115,000,000 people of North America is at this time a matter of speculation and, so far as I know, there are no data on which such a computation can be based. However, an estimated number might be fixed to serve as a target for criticism, of at least one surgeon to 10,000 persons. This percentage is about the same as that furnished to England by the Royal College of Surgeons of London. That there will be, in the next decade, such a number of eligible men, I am confident. Objection has been raised to an association of so large a membership; it is maintained that this would mean a lowering of educational standards. If the principle is established that the association first of all is for the benefit of the people, I believe a working arrangement can be made which will, in a tentative way, meet the requirements. The next generation will not be so greatly troubled as the present one by questions of educational standards. The medical standards of the whole country have been raised to a point not exceeded by those of any other country in the world. In the present generation, by reason of divergent standards, there will have to be a certain amount of latitude to meet the existing conditions.

Knowledge obtained by observation, experience, and from the printed page, is possessed by many men. When knowledge is translated into proper action we speak of it as wisdom. Many men have great wisdom, in their knowledge of useful things, yet may have but a limited book learning. Personally, I believe that the wise honest man who can bring a high order of skill to bear on surgical infirmities should not, at least in this generation, be refused admission to the College because of a lack of fundamental training.

In the adoption of standards or requirements for admission into the American College of Surgeons, character should be first considered. The dishonest, conscienceless man who has surgical skill is most dangerous in any community. Unnecessary operations, even when performed with a high order of technical ability, are the bane of present-day surgery, but, owing largely to the American College of Surgeons, such practices are markedly on the wane. However lenient we may be in estimating the value of the older and disap-

[1] Delivered at the Seventh Convocation, New York City, October 24, 1919.

pearing generation of surgeons, our standards for the younger and coming generation of surgeons, who have had and who will have had opportunities to acquire learning, should be high and increasingly high as future standards and educational requirements are raised.

In the future, the American College of Surgeons will not only demand that the candidate shall be a graduate of a reputable medical school and have had hospital experience and be licensed to practice, but also that he shall have had special training in the particular surgical specialty which he intends to practice. In making these requirements it is the duty of the College to see that facilities for obtaining the special training are developed. Three years at least will be required for such special training. At the present time the man who possesses the B. S. and M. D. degrees and has had one year of hospital training averages 27 to 28 years of age. Add three years to this training and he is 30 to 31. Will this secure the best results or will the man reach his life work at too late an age? We must also consider that during the entire period of his education he is not self-supporting. Will not this have a tendency to make the surgeon a member of an aristocracy to the ranks of which the sons of rich men will be the only ones who will have easy entrance? Investigation was made of the professional standing of the graduates of the medical department of the University of Michigan fifteen years after graduation. It was shown that those who graduated before their twenty-fifth year had made, on the average, greater scientific progress and were a greater asset to their community than those who graduated after the twenty-fifth year.

I think we are all agreed that the actual time spent in the professional part of this education should not be shortened. I think we are also agreed that one of the faults of the educational system of our country is a loss of time and effectiveness in the preliminary educational methods. The university has been made the base of our educational system and it should be the apex. Only a small percentage of those who enter our public schools ever reach the university, yet the university greatly influences the educational policy even in the grade schools. I am convinced that at present two years of time are lost in the grade schools, and that the education given is not altogether the most desirable for the making of American citizens. A six-year course of grammar school education, divested of any university significance, should be a strict government requirement in all schools, private as well as public, and given in the American language. It should be the purpose to give a common education in the common things that are to make us a united people, and such an education might well be made a requisite for the exercise of suffrage.

The high school could be reduced to three years instead of four, and in it for the first time should the university be considered. Languages should be optional in the high school, but I believe that Latin and modern languages are of great value to the professional man. The high school now recognizes the material facts of life, and gives an education in mechanics and agriculture, business, and the industries, as well as the traditional cultural education, and these courses should be further extended.

It is sometimes difficult to follow the academic mind. The more or less cloistered life that is led by many college professors has given traditional cultural education too great an influence. Modern educators today do not believe that teaching in one subject as, for instance, mathematics, has greater power of mental training than other subjects. The old time educator would consider this rank heresy. His mind still clings to the view that any education which might be used commercially is not cultural, a view which is wholly undemocratic and based on an out-worn caste system.

In no place has this traditional view of education been more pronounced than in the universities. It has been only within recent years that the university faculties would accept the view that the anatomy and physiology of man had cultural training value, although they were convinced that the anatomy and physiology of plants had such value. There has been a slowness of universities to give credits for any kind of work which might be used for gaining a livelihood, even so holy a cause as caring for the sick. And today, less credit is given in these subjects than for others which have no more training value. Do not understand me as desiring to lower the standards of universities in relation to cultural education. Far from it; but I do object to the present attitude which desires to force every type of education into the one mold. The great problem now is to obtain the money to give an education to all those who desire it. The purpose of the university is to give an education not to the few, but to the many; and it should be emphasized that the giving of degrees is only incidental to this purpose. Every unnecessary step, every unnecessary regulation which delays or obstructs the progress of a student prevents some one else from obtaining an education. The academic answer is: Raise standards until the number of those

who can—not desire, but can—obtain an education is reduced to the number who can be given the present form of education. Our country depends not on a cultured class alone, but on the average intelligence, and in the last analysis on the number who will be able to obtain an opportunity to get an education. It should be the duty of the Fellows of the American College of Surgeons to see that certain existing conditions be remedied so that the medical schools may graduate their students at an earlier age.

In this connection, I quote from the 1918 report[1] of C. G. Schultz, superintendent of education of the state of Minnesota, now of the Government Department of Education, Washington:

"It requires a total school enrollment of approximately four hundred fifty to produce one college graduate. No one questions that it is desirable that this one graduate should be produced. But that a large part of the energies of a school community should be devoted to this end seems lacking in sound business sense. Surely such a procedure in no way contributes to the fulfillment of our democratic ideal of the open door to equal opportunity. In order that we may prepare one pupil for college we cannot justify the neglect of those forms of training distinctly desirable for the four hundred forty-nine who must follow pursuits other than those open to the college graduate. The same reasoning leads to the conclusion that we cannot justify our insistence upon the maintenance of high schools for the sole purpose of training all pupils to go to college when only one out of ten goes and only one out of thirty graduates."

The expense of our educational system is a serious burden on our taxation resources. By efficient methods a much greater percentage of our young people might secure higher education without an increase of the present burden. The average child should not be entered in the common school under the age of seven, but should be taught in the kindergarten, given six years in the grade school, and three in the high school. At sixteen the student who desires it is ready for university training. The freshman and sophomore years, under university supervision, may be given in the home high school under home influences. At the more mature age of 17 to 18 the students leave for the junior and senior years in the university. Such a program contemplates cutting only three years from the grade and high schools, does not increase the cost, and doubles the capacity of the university for the giving of advanced education. This is not purely theoretic; such university high school courses are now given with university credits in some of the cities of Minnesota, among others Rochester, where C. H. Mayo, as one of the city school commissioners, has made the plan a success.

Another problem for which some wise solution must be found is the future management of the annual clinical meetings of the association. Even at the present time, with a limited membership, there are few cities in this country that can adequately care for the visitors at the meetings. It may be that a partial solution will be found in the development of clinical meetings to be held in various states or parts of the country in addition to the annual meeting for the convocation. It has also been suggested that the attendance at the annual meetings shall be limited to the members of the association, but, inasmuch as it is our intention to make the fellowship the first goal of the ambitious young surgeon after the completion of his training, it would seem that, so far as possible, promising young men should be admitted as invited guests.

In developing the sectional clinical meetings it should be borne in mind that the essential idea is educational—to develop better surgery. We must, however, remember that we, as a College, have a duty to perform to the public and to the profession, and this can best be brought about by close affiliation with the organizations representing medicine as a whole. We urge upon every Fellow that he become a member and a conscientious worker in his County and State Societies, and in the American Medical Association.

Men who cannot become fellows because of lack of moral character should not be allowed to give demonstrations or hold clinics under the auspices of the College.

Finally, I would call attention to the desirability of making the College of Surgeons truly American, by affiliation with the universities of the sister republics in South America. The University of Lima, Peru, is the oldest university in America, and many of the South American universities have attained pre-eminence as educational institutions, with whom it would be of great benefit to be associated. I am sure a way will be found to consummate so desirable an alliance.

[1] Twentieth Biennial Report, Department of Education, Minnesota, 1917-1918.

THREE RECENT EPOCHS IN THE HISTORY OF THE CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA[1]

By JOHN G. CLARK, M.D., F.A.C.S., Philadelphia

THE Clinical Congress of Surgeons of North America has participated in two epochs world-wide in their tragic importance, within the last three years. The first marked the entrance of the United States as one of the Allies in the Great War; the second witnessed the frightful epidemic of influenza last year; and we are now standing upon the threshold of the third, or transitional event—a new era in American medicine.

The session two years ago in Chicago was of a highly inspiring character, for this great organization, constituting a guild of our best and most earnest surgeons, was stirred to the very acme of patriotic enthusiasm by the events which transpired at that meeting. In addition to the Secretary of the Navy, three of our Surgeon-Generals and other distinguished figures in surgery, who had been known to us as skilled masters in our profession in civil practice in their respective countries before the war, came to us as military ambassadors, bearing messages of grateful appreciation from their countries for the magnificent effort we were then displaying in the organization of a virile Medical Corps to replenish the sorely depleted surgical ranks of the war ridden zone.

After that remarkable meeting, our foreign guests returned to their homes, carrying a revivifying inspiration to their wearied armies, for they had witnessed the awakening of a lusty national giant from a lethargy of neutrality. Out of this association went the surgeons who became the very heart of the Medical Corps, and sitting in the audience this evening are innumerable Fellows who have returned to us decorated with the highest honors, bestowed by our own and grateful allied nations.

Indefinitely could one dwell upon the glorious deeds of our Medical Corps, but others will pay a more worthy tribute to our heroes than is possible for me to express. During the year following the Chicago session, our Secretary General, Franklin Martin, the genetic and dynamic force behind this organization, although engrossed with the many difficult tasks of his high office as the medical member of the Council of National Defense, was working indefatigably upon the details of the forthcoming New York meeting. Again were delegated to this country from the Allied nations many distinguished surgeons from England, France, Italy, and Belgium, but after that delegation had set sail for New York, the outbreak of influenza, which developed into a veritable pestilence, fell upon this country and became especially virulent upon the Atlantic seaboard. Notwithstanding our Secretary General had previously been importuned to let the meeting lapse on account of military exigencies, the urgent opposition of mere man could not thwart his Jacksonian tenacity, but he was forced by this frightful interposition to capitulate. Only those who know his continuity of purpose and how persistently he worked for the success of that meeting can realize with what reluctance he prorogued that session until this year. However, he, with the co-operation of your new President and our New York hosts have arranged for this week a bigger and better clinical program than ever before. The loss of last year, therefore, is amply made good by the excellent series of papers and clinics, which will be given by the New York and Brooklyn surgeons to our Fellows and guests.

With the outbreak of the epidemic of influenza began the second noteworthy epoch in the medical history of our country, a period filled with appalling issues. The physicians at home were heavily burdened with the added cares of their absent colleagues, and were almost overwhelmed with the searching trials that followed.

In addition to the established hospitals, churches, warehouses, and armories were hastily equipped as emergency hospitals and our physicians and nurses served quite as valiantly and many died as nobly at these posts of duty as did the heroes of the Argonne. Two great armies of physicians were then at war—one making the great sacrifice in honor of their country—the other in sustaining our national civic life, so necessary for the construction of an impregnable industrial and financial bulwark behind our armies. The medical profession has emerged gloriously from these two colossal crises, and we are now on the threshold of the third great epoch—a new era in American medicine.

The European nations are grievously impoverished, and their great educational systems must of necessity suffer for at least a decade before recovery is possible. They have sustained

[1] Address of retiring president, New York City, October 20, 1919.

an irreparable loss in that youthful spirit which Sir William Osler has so wisely said is essential for inventive progress, and it will require at least twenty years to restock the scientific storehouses in those countries to which we formerly made our postgraduate pilgrimages. Are we prepared to carry on while they recover? If not, we will lose one of the inestimable opportunities that this war has thrust upon us. We Americans do not deliberately seek scholastic ascendancy over any other nation, for we have witnessed the frightful havoc wrought by an egotistic "kultur," but we are in duty bound to fill the gap and to score an advance in progressive medicine while the scientific ranks of Europe are being regenerated.

With the completion of our martial activities, great numbers of young surgeons have returned and many have eagerly resumed their places in our schools and hospitals as teachers, invigorated with new ideals and filled with youthful energy to pursue them. Many other returning physicians, who have found themselves through the mighty force of circumstances created by their war activities, are newly possessed with a desire to take up intensive study in various special branches, so that they may better their positions in medicine, instead of falling back into the humdrum of small practice. It requires no prophetic vision to forecast what will transpire when our greatly augmented transportation fleets again take their places as the carriers of international commerce, especially to our South American neighbors. There will then be an influx of students from the southern countries, both to our undergraduate and postgraduate schools. To such men we should be prepared to offer ample facilities for postgraduate study, not of the old commercial type, such as our schools have been guilty of purveying in the past, but a full and comprehensive training of sufficient length to lead to a master's degree. The wretched postgraduate instruction of past years should be cast into the discard and courses should be arranged of such essential value that upon their completion by a student his diploma or certificate will be a real and trustworthy evidence of his ability to practice in that special branch. The six weeks', or even the six months' course of previous years was little less than a "bunco" game, in which the postgraduate student was given a smattering imitation of knowledge, and he in turn went into practice delivering the same deceptive article to his patients. It has been said that the patient who pays five or ten dollars as an obstetric charge is usually cheated, so likewise is the postgraduate student dealt with who takes a six weeks' postgraduate course, be his tuition fee small or large.

We have spoken much in this country of research, and, under the guidance of a false stimulus, men have attempted to carry on phases of investigation who are as capable of attaining a successful issue as a farm horse would be of winning the Royal Derby. Although the great geniuses of science have brought forth their epoch-making discoveries under the most adverse circumstances, and such geniuses will still attain pre-eminent places in the scientific firmament under similar difficulties, the average investigator, however, cannot work against such obstacles and achieve results. Fortunately, there have sprung up in this country a few special laboratories and hospitals in which men capable of real research work may be trained. That the number of such institutions must be increased is absolutely essential for a stable scientific growth. Out of every medical class of one hundred there may possibly be but one graduate who really has a creative mental capacity or bent for scientific investigation. These men should be segregated and fed upon such mental pabulum as will bring out their best capabilities, and while pursuing this work they should be shielded from the carking cares of earning a livelihood by liberally endowed scholarships. As directors of departments of research, men of broad training and culture are required; those, who through copious fertility of ideas, are always ready to direct the scientific pioneer along lines that are most likely to lead to valuable discoveries.

The new epoch, therefore, should become the renaissance in American Medicine, combining all of the sterling quallties of our intensely practical natures with that fine sense of research and investigation which shall make so much more comprehensive and also more efficient the medical education of the coming generation of physicians.

REPORT OF THE SECRETARY GENERAL OF THE CLINICAL CONGRESS OF THE AMERICAN COLLEGE OF SURGEONS AND OF THE AMERICAN COLLEGE OF SURGEONS

I. Organization of the Congress and the College
II. The Permanent Administrative Home
III. Endowment Fund
IV. The Work of the College

By FRANKLIN H. MARTIN, M.D., F.A.C.S., Chicago

IT is desirable in this, the annual report of the Secretary General, to summarize briefly the paramount developments in the organization and administration of the Clinical Congress and of the American College of Surgeons since their inception. This is particularly appropriate inasmuch as we have been so preoccupied with war problems during the past three years that the exigencies of the situation have prevented a detailed report to the Fellows since November, 1916. This does not imply, as this report will endeavor to demonstrate, that the work of the College has been neglected for this period of time, nor that we have failed to carry out many of our original plans.

I. Organization of the Congress and of the College

The organization of the Clinical Congress and of the American College of Surgeons was not an accident. Fundamentally, surgery is a mechanical art, and its intracacies can be adequately illustrated only by a master of the art, through actual exhibitions of his work at the operating table in the hospital. Several great clinics of the world had demonstrated the value of this form of teaching, and a group of our wisest men had made it the basis of an exclusive travel society of surgeons. The superiority of clinical demonstrations as a means of interesting surgeons in surgery compared with the usual academic society proceedings with scientific papers and discussions made obvious the fact that this clinical society could not be confined to a group of half a hundred men. This recognition resulted in a meeting of a large number of the surgeons of the country to watch the leaders of one of our great medical centers do their work in their accustomed environment. The outgrowth of this assembly was the organization of the Clinical Congress of Surgeons of North America, the first natural step in the creation of the American College of Surgeons.

As a supplementary control of the informal clinical society, the College was inevitable because of the popularity of this form of society and its appropriateness in imparting information about surgery. It soon became obvious that no single clinic, nor all of the clinics of any large city, could accommodate the aspiring surgeons of the country who desired to attend the meetings; and because of the variety of surgery shown at these informal meetings, it was made equally apparent that if we were to reap the maximum benefit from the clinical meetings, it would be necessary to standardize the surgery that was exhibited at these sessions. These facts argued for an organization that would establish for its Fellows a minimum standard of education, ethical status, and technical capabilities; that would aid in limiting unnecessary surgery and work for the making of better surgeons in all communities. It was suggested that the roll of membership should contain only the names of those surgeons who would subscribe to these principles, and who, in the estimate of their associates, would seek to sustain them. As the result, at one of the greatest meetings in the history of the Clinical Congress, with twenty-six hundred surgeons in attendance here in New York in 1912, the new society to be known as the American College of Surgeons was created from the loins of the Clinical Congress, and the plan of procedure was announced from this platform. A strong committee with power to act was appointed by the President of the Congress to consider the advisability of establishing an American College of Surgeons. This committee forthwith took charge of the proposed organization, and its development was begun.

In May, 1913, at Washington, five hundred surgeons of the country who were agreed that the development of the idea was desirable assembled and formally launched the American College of Surgeons. The College became a reality in November, 1913, one year from its

birth, when, under the approval and god-fathership of the then President of the Royal College of Surgeons of England, Sir Rickman J. Godlee Bart., the first Convocation was held, and the Fellowship of the College was extended to ten hundred and fifty-nine surgeons. Ten hundred and sixty-five Fellows were enrolled in June, 1914, in Philadelphia; six hundred and forty-six in Washington in the Fall of 1914, and a smaller number each year thereafter, until with this year when the Roll of Fellows of the College comprises over four thousand surgeons of the United States and Canada.

SELECTION OF MEMBERS

The selection of members for the society from among the thousands of applications on file necessarily required the most judicious handling. This involved considerable preliminary work in fixing standards, and creating machinery of administration that would act efficiently, effectively, and disinterestedly. This second stage of organization may well be called the epoch of personnel.

FINANCING THE ORGANIZATION

The epoch of financing was the third undertaking. It soon became apparent to the officers that the original plan of financing the organization was entirely inadequate to cope with the educational responsibilities that were thrust upon the College. The contribution by each member of fifty dollars outright, or at his option paying a twenty-five dollar initiation fee and five dollars for five years thereafter, would merely provide for the routine administrative expenses and would be insufficient to finance an educational campaign which would require a corps of paid experts and other machinery of propaganda. It was, therefore, proposed at the Philadelphia meeting in 1914 that an endowment of one million dollars, in five hundred dollar units, be subscribed by the Fellows of the College before November, 1914. Because of the uncertainties which resulted from the precipitation of the European war, in August, 1914, the Regents asked for an extension of the time limit to November, 1915. This extension was granted by a referendum vote of the Fellows who had already subscribed to the fund. As a consequence, at the expiration of the new date the five hundred thousand dollar fund was oversubscribed by thirty-six thousand dollars.

In the meantime, many suggestions came to the Regents from the Fellows in regard to the equalization of the financial responsibility. At the Philadelphia meeting in October, 1916, a resolution embodying these suggestions was put to a vote of the Fellows, namely, that those who were not subscribers of a lump sum to the endowment fund should pay twenty-five dollars a year dues, such payments to be made until the Fellow had reached the age of sixty-five, or until he had contributed an aggregate sum of five hundred dollars; that the Regents be authorized at their discretion and without publicity to cancel the dues of any Fellow to whom such payment would be a hardship; and that all Fellows who had subscribed five hundred dollars to the endowment fund be exempt from dues. This resolution was unanimously adopted.

II. The Permanent Administrative Home

Since the inception of the American College of Surgeons, a paramount problem in its organization has been the one of fixing its permanent central administrative home. From the beginning, in the minds of its friends and organizers, the American College has been compared with the Royal College of Surgeons of England, with its nine centuries of accomplishments; its dignified home in Lincoln's Inn Fields, London; its Hunterian Museum; its great medical library; its collection of paintings and busts of the men who made the history of surgery; and its storehouse of traditions of unprecedented value. The American College of Surgeons, comprising the surgical profession of the United States and of Canada, and representing a population of one hundred and fifteen million people, must, they conceived, have a home which will compare favorably in dignity and importance with that of its predecessor in England; and while the counterpart cannot vie with the original in traditional treasures, it can offset these by compensating advantages that accrue to the College because of its greater field of activity and its newer methods of attack.

Confronting the Regents at the outset in the consideration of a permanent home was a threefold problem—location, financial means, and scope. The most important phase was the location, because of the inevitable spirit of contest that necessarily ensues when many individuals having varying ideals and residing in widely different areas are to be satisfied.

At the Philadelphia meeting in 1914, the Regents, as the result of a spirited discussion of the subject of a permanent home, appointed a committee to consider the matter, with Admiral Charles F. Stokes, formerly Surgeon General of the United States Navy and a resident of Washington, as chairman. This committee

presented a tentative report at the Washington meeting of the College in 1914 which distinctly favored Washington as the home of the College inasmuch as it is the capital of the United States, the center of population of the East, and a distinctly neutral ground. While the report was tentative and not supported by a definite recommendation, it was loudly applauded by a large number of the Fellows present. It was not, however, made a subject of vote because it had not received the cordial endorsement of all of the Regents.

The subject of location was discussed by the College from three principal standpoints: First, should the home be situated in a medical teaching center? Second, should it be in the capital of the nation, which would also have the advantage of neutrality? Third, should it be in a geographical and medical teaching center of the United States? The greatest difference of opinion in the minds of those who discussed the matter at all seemed to be between the capital of the United States and one of the medical centers. After the aforementioned Committee had submitted its report and recommendation, the subject of the future home of the College aroused an interest among many Fellows who had previously given it but little thought, and it became apparent that an opinion was developing which more and more favored one of the medical centers.

In the meantime the European war, since it was inevitable that we were to be drawn into it; was occupying our minds, and the problems of our medical societies and of the College were temporarily dwarfed.

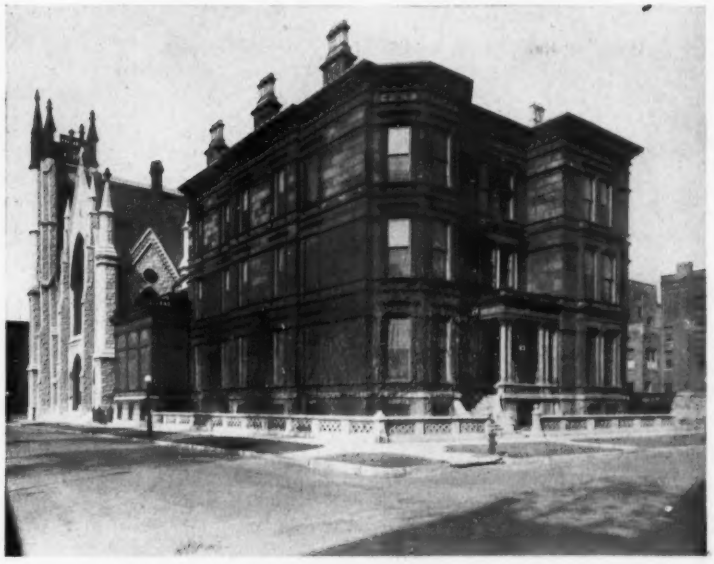
CREATION OF THE JOHN B. MURPHY MEMORIAL ASSOCIATION

But the horrors of an European war could not distract us from the great loss that the medical profession, and especially the surgical profession, of the world sustained in the death of one of our most distinguished Fellows and one of the most influential founders of our College, Dr. John B. Murphy. His death, occurring as it did at the height of his activity and influence, brought us face to face with the mutability of our transient problems. It also brought vividly to the minds of his nearest friends his transcendent interest in the American College of Surgeons, and his regret that, at the time the permanent location of the College was discussed, Chicago, the city in which he had done his work, was not even seriously considered. But before he had been laid to rest, a host of his lay friends were discussing and planning a suitable memorial for this great man—something other than bronze or marble; something connected with his life's work; something useful; something essential; something enduring; something in Chicago.

The suggestion that in the permanent home of the American College of Surgeons a memorial hall bearing his name be dedicated to his memory, as the Hunterian Museum of the Royal College of Surgeons commemorates a leader of surgery of England, appealed to these friends, and an organization known as the John B. Murphy Memorial Association was immediately incorporated. The plans of this Association contemplated securing from the municipality of Chicago or the citizens of Chicago a gift of land on which could be built the first unit of the future home of the American College of Surgeons, the buildign to be known as the Murphy Memorial of the College.

It was obviously necessary that the tentative plans of this organization should be immediately considered by the College and a decision efinitely rendered. It was mid-August and the Regents were scattered, enjoying their vacations. The Chicago contingent—the Treasurer, the Director and the Secretary General—realized that favorable action could not be authorized in the tentative emergency offer of the Memorial Association without the consent of the Regents of the College. The Director and the Secretary General visited the President of the College in Nova Scotia, and in accordance with the program which was formulated at this interview the Board of Regents met on call in New York City on September 20, 1916, with the following members present: Edward Martin, George E. rewer, Frederic J. Cotton, Charles F. Stokes, BGeorge W. Crile, Charles H. Mayo, J. M. T. F nney, and Franklin H. Martin. The plan of thei Murphy Memorial Association to locate the College in Chicago on a suitable site that would be furnished to the organization without cost, and on which would be erected one of the first structures or units of its home, to be known as the Murphy Memorial, was presented in detail and was unanimously approved. The Regents realized, however, that their judgment should be confirmed by a referendum vote, accorded to all the Fellows. This was done by mail and out of 1865 votes cast, 1550 favored Chicago, the 315 scattered votes favoring other cities.

The Memorial Association perfected its organization. Then occurred our entrance into the world war. The President of the Association, Mr. Hurley, was placed at the head of the United States Shipping Board; Judge John Barton Payne, a member of the association, be-



The south and west exposure.

came chief counsel for the same Board, and other members were called to Washington for an indeterminate period. Seventy-five per cent of our Canadian Fellows were already in France; in six months fifty per cent of the Fellows of the United States were in uniform, and fully thirty per cent additional were doing other important work for their country. For two years all work of the committee was necessarily abandoned.

With the signing of the Armistice, however, the frayed ends of peace-time were gathered up. It had been deemed possible that a site might be given to the College by the park commissioners of Chicago. Later, however, it developed that such a location might be attended by many legal difficulties, and might at some later day involve the College in undesirable political complications.

POSSIBLE SITE IN CHICAGO

This view of the situation, substantiated by the best legal advice that could be secured, was imparted to the Regents at their meeting in Atlantic City in June, 1919, with the suggestion that the College accept, in lieu of a location in a public park of Chicago, a suitable site purchased by the citizens of the city and made an outright gift, free from all entangling alliances, to the College.

In the discussion that followed, it was made clear that the Regents favored the selection of a medical center rather than a neutral city. This opinion, supported by the referendum of the Fellows which had definitely favored Chicago, determined the Regents to authorize the Secretary General to negotiate for a site in Chicago which was already under contemplation, and to accept it in the name of the College as a gift from the citizens and Fellows of that city. A time limit of sixty days was given the Secretary General in which to accomplish this work.

A purchase price was secured, and on July 1, 1919, after consultation with and obtaining the approval of the President, the Treasurer, and the Director, the Secretary General took a forty-five day option, the utmost that could be obtained on the property that was afterward secured, and immediately proceeded to raise the money for the purchase. August 15th was the last date on which the option and the five thousand dollar guarantee could be redeemed.

The price placed on the property was one hundred thousand dollars, which was practically the value of the land. The property surrounding the site is in the process of transition from the most exclusive residence district of Chicago to that of high-class hotels and apartment buildings. Therefore, when the land is sold for business purposes, these residences are considered a liability rather than an asset, because of the expense of

The south and east exposure showing vacant portion of lot available for future improvement.

wreckage. Many of them, including the one secured by the College, cost fabulous sums to build thirty years ago. Inasmuch as the building that goes with the College property is occupied now as a residence by the people who have owned it for many years, it has been kept thoroughly modernized and is in a perfect state of preservation.

To facilitate our campaign in raising the money, we divided the amount into two parts—seventy-five thousand dollars and twenty-five thousand dollars. We honored the millionaires by assigning to them the larger sum, and insisted that the Fellows of the College living in Chicago be content to contribute the smaller amount. The Association of Commerce interested itself in our task and gave us not only good advice but material assistance in planning our campaign. The real raising of the money, however, came by hard work in the way of personal solicitation. Two days before the option expired we were thirty thousand dollars short of the necessary amount. On Saturday, August 15, two days later, we had to give notice of acceptance of the property or lose it, with our deposit. While there were a number of good prospects in sight, actual subscriptions were not in hand. To fulfill to the letter our instructions from the Board of Regents, as recorded by their vote, the accepted site must be guaranteed to the College without a cent of the purchase price coming from that institution. The Secretary General took the matter to the Treasurer; what could be done to save the seventy thousand dollars already subscribed and to secure the home of the College? It was decided that the Treasurer and the Secretary General should personally underwrite the outstanding balance, and notice of the purchase of the property was given. Today the deficit on the guarantee is eleven thousand dollars. A number of good prospects are being followed up, and there is no doubt that the whole amount will be subscribed before December 1, and the underwriters of the diminishing deficit released.

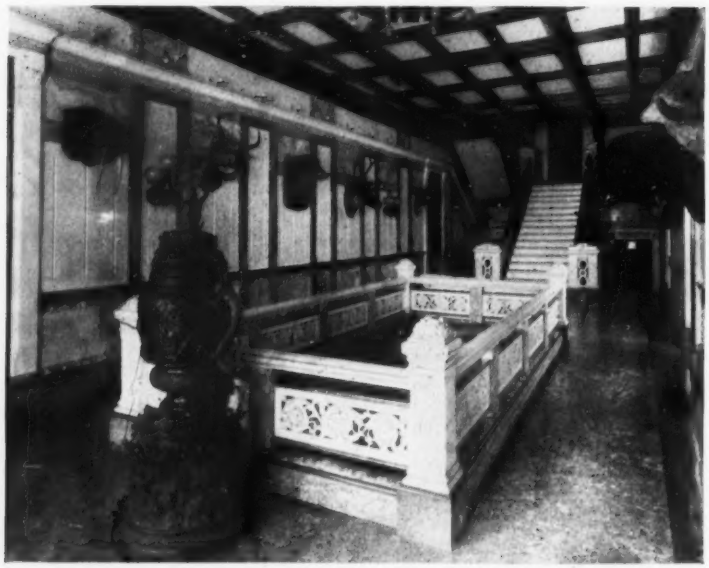
In the meantime title to the property has been taken in the name of the College, and sixty thousand dollars paid on the contract. The house has been rented to the late owners and present occupants until March 1, 1920, for a sum considerably in excess of the rent that we are now paying in our temporary quarters. The property which has been purchased for the College is located on the northeast corner of Cass and Erie Streets. The building faces Erie Street and is a block and a half west of the main driving thoroughfare, Lake Shore Drive, with a two-minute bus service from and to the loop center; it is one block east of North State Street, with a through line of trolley cars; it is less that a mile from the most distant hotel; it is a five to ten minute walk

The lower entrance hall.

from the loop. The lot has a frontage of one hundred and fifty feet on Erie Street, and a depth on Cass Street of one hundred and nine feet. It occupies the south-west one-fourth of the block, giving the building a south and west exposure. The present building, occupying sixty-five feet of the lot and extending its full depth, was built thirty years ago at a cost in excess of four hundred thousand dollars. The building has a three story and basement elevation, and is constructed of steel, Bedford stone, bronze, and marble; it presents the dignified appearance of a building erected for semi-public and semi-business purposes, is thoroughly fireproof throughout, and is eminently suitable for the purposes of the College. The present owners have within the past ten years spent a considerable sum of money in adding a new heating plant, an up-to-date lighting system, and other modern improvements. There is sufficient vacant space upon the property to meet our future needs, including the Memorial Hall, and in case of extraordinary expansion additional ground may be secured.

In taking stock of this possession which has come to the American College of Surgeons through the generous gift of the lay and professional citizens of Chicago, we find ourselves greatly enriched in the needed assets of the College. Our present temporary quarters are thoroughly inadequate, and with a renewal of the lease, which would have been necessary in May, our rent would have been increased to six or seven thousand dollars a year and we would still have been handicapped by a makeshift. The new building furnishes immediately a dignified clearing house for our organization, and administrative offices that will be adequate for its purposes for a great many years. If the building had been erected to supply the administrative needs of the College for fifty years to come, it could not have been a more convenient structure than this in points of space and arrangement of rooms. However, we are not providing for the immediate present alone in obtaining this property but for the remote future, and we have the satisfaction of knowing that our holdings will advance rapidly in value since the next extension of the business loop in Chicago will in all probability include our property.

Having provided for our immediate administrative needs in this present building, what will be our subsequent moves? First, the building of the Memorial Hall and accessories; second, the establishment of a working museum, with its building and upkeep independently endowed; third, also through independent endowment, the establishment of a department of literary research, either with or without a medical library.



The upper hall.

The drawing room and library.

The library and den.

III. Endowment Fund

The fourth problem which the Fellows of the College should bear constantly in mind is the completion of our one million dollar endowment fund. One thousand and twelve men of our four thousand Fellows have subscribed five hundred dollars each to the endowment fund. This fund is a permanent one, invested in municipal and government bonds, only the interest of which can be used to defray the expenses of the College. No part of the principal may be spent for land or brick and mortar. Those Fellows subscribing to the endowment are exempt from the payment of dues. It is hoped that a considerable number of the three thousand Fellows who have not subscribed to this fund will do so in order that we may reach our goal, and still further substantiate our organization.

IV. The Work of the College

The postponement within a fortnight of its opening of the session of the Clinical Congress last year, because of the influenza epidemic, was a great disappointment because of the work that had been so painstakingly accomplished by the untiring Committee on Arrangements of New York and by the officers of the Congress; also it deprived the Fellows of the College and the members of the Congress of the usual valuable inspiration that these meetings impart.

Credentials Committees

As the result of an unlimited amount of work, the State and Provincial Committes on Credentials have added to our list a large number of Fellows. There are now on file in the office of the College approximately five thousand names of applicants. The Credentials Committees and the Committee on examination have pursued their work conscientiously. The fact that less than one hundred and fifty candidates have been admitted to Fellowship this year out of the large number of applicants argues for the thoroughness of their work. As proof that the small number of

The library and den.

The directors' room

Fellows admitted is not due to default of enterprise on the part of the Committee on Examination we have only to state that out of every one hundred sets of examination papers reviewed by the Committee less than fifty were approved. Many of the candidates who have submitted case reports have been notified of minor errors and have been asked to resubmit papers or to revise or supplement their original ones. The office has endeavored to deal punctiliously with all candidates in giving them information, through correspondence or by personal interviews, and as far as practicable in giving them the status of their candidatures.

The report of the Director will record the campaign on hospital standardization which has extended over a period of three years. The survey furnishes material that should establish the authority and right of the American College of Surgeons to pursue and guide the program that it has so effectively established. The definite plan that is laid down for the guidance of all who are interested in hospital standardization is particularly acceptable at this time. It states what has been accomplished, what should be accomplished, and outlines the means of accomplishment. The minimum standard on which this survey has been conducted is clearly defined. The general hospitals of the United States and Canada which are known to meet the minimum standard established by the College are recorded by the College for future announcement. Out of a total number of 617 general hospitals in the United States having a capacity of one hundred beds or more, 190 are listed as meeting the minimum standard, while out of a total of 34 of such hospitals in Canada, 8 are recorded as meeting the standard.

SECTIONAL CLINICAL MEETINGS

In addressing the five hundred Congressional Representatives of the United States and of Canada in twelve separate groups in the last two days, it has developed that there is a strong desire on the part of this decentralized part of our organization to establish sectional clinical meetings. This proposition has been discussed by the Regents, and a meeting of the Executive Committees of the Congressional Representatives of the various States and Provinces will be called at some central place within the next month or two to discuss and adopt a uniform plan to be followed in the organization of the state or sectional clinical meetings.

PRESENTATION AND ACCEPTANCE OF THE ADMINISTRATIVE HOME

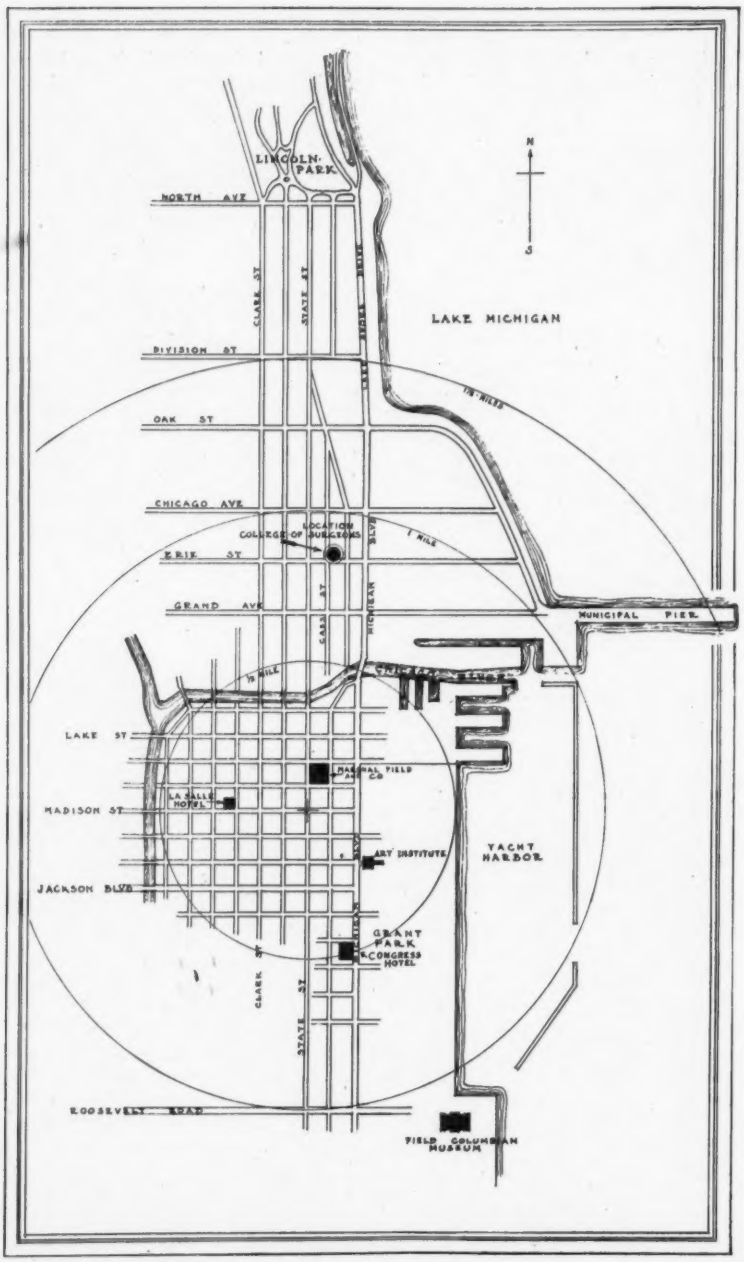
At the conclusion of his report the Secretary General presented to the President and to the Fellows the gift from Chicago citizens and members of the College of the property and building at 40 East Erie Street, Chicago, described above to be used as the permanent administrative home of the College. Dr. J. M. T. Finney, upon request from the Chair for a resolution concerning the gift, made the following motion:

WHEREAS, the citizens of Chicago have presented to the American College of Surgeons, for a permanent administrative home a site and building at 40 East Erie Street, Chicago,

BE IT RESOLVED, that this site and building be accepted and a suitable letter of thanks expressing appreciation of the gift be drafted and forwarded to the citizens of Chicago.

As one of those who from the start had consistently favored Washington as the site of the permanent home, Doctor Finney, upon the seconding of his motion, asked for the privilege of making a few remarks concerning the resolution he had just proposed. He said:

"There has been some misapprehension in the minds of a number of the Fellows as to where the College really stood on the question of the location of a home, and it affords me great pleasure to offer a word of explanation in order that this misapprehension as to the facts of the matter may no longer exist. The Committee appointed to consider a site for the College favored on the whole the City of Washington, although they could come to no unanimous decision. At the annual meeting held in Washington, November 16, 1916, the feeling of the Board of Regents was not in perfect accord concerning the site, and, therefore, as President and presiding officer, I did not ask for a vote. Subsequently the matter was thoroughly discussed at various meetings, and in June, 1919, in Atlantic City, five Regents who had previously favored Washington unanimously and enthusiastically voted in favor of Chicago. The experiences of these men in Washington and in Europe during the War brought them to the conclusion that while there were obvious advantages in the Capital as the governmental and political center of the country, there were more definite and potent reasons why it was unsuitable for the permanent home of the College. Furthermore, the vote by letter of the



Plat showing location of new home of American College of Surgeons in relation to business section of Chicago.

Fellows was overwhelmingly in favor of Chicago, and the offer at this time of the splendid property just purchased seemed so opportune and advantageous that, since there was no good reason for holding out, it seemed clearly a duty to reach a decision, and that decision was in favor of Chicago."

Doctor Finney's motion carried unanimously.

COMMITTEE ACTIVITIES

AUDIT OF ACCOUNTS OF THE CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA AND OF THE AMERICAN COLLEGE OF SURGEONS

The president of the American College of Surgeons deemed it advisable to review the affairs of the College and of the Clinical Congress of Surgeons of North America in order that their organic union might start with full knowledge of the financial and business status of both organizations. He therefore appointed an auditing committee of five with authority to make this survey. It met at the offices of the College on December 31, 1917, and after a thorough examination of all books, papers, and records concerning the business of the American College of Surgeons and of the Clinical Congress of Surgeons of North America, submitted the following report:

We, the Auditing Committee of the American College of Surgeons, find the accounts of the American College of Surgeons and of the Clinical Congress of Surgeons correct in all respects, the methods of bookkeeping accurate, and proper vouchers and receipted bills for all moneys paid out. Money has been spent only with proper authority and for value received.

We desire to express to Dr. Franklin H. Martin, secretary general, our appreciation of the vision, courage, and sincerity with which he originated and developed the American College of Surgeons and the Clinical Congress of Surgeons of North America, and brought to a consummation the recent absorption of the latter organization by the former. The records show that Doctor Martin has at great personal sacrifice both of time and money made this result possible. We also wish to acknowledge our debt of gratitude to that master surgeon, the late Dr. John B. Murphy, for the aid he gave in promoting higher surgical education and fostering purer professional ideals.

(Signed) William J. Mayo, *President*
William W. Pearson
Miles F. Porter
Arthur D. Bevan
George David Stewart

APPOINTMENT OF COMMITTEES

Committee on Industrial Surgery — Edward Martin, Philadelphia, chairman.

Committee on Military Preparedness — Joseph A. Blake, New York, chairman.

Committee on Post-Graduate and Research Work — John G. Clark, Philadelphia, chairman.

REPORT OF NOMINATING COMMITTEE

The report of the Nominating Committee resulted in the election of the following:

President: George E. Armstrong, Montreal.
First Vice President: Rudolph Matas, New Orleans.
Second Vice President: Horace Packard, Boston.

BOARD OF REGENTS

Term Expiring 1920: Robert E. McKechnie, Vancouver; William D. Haggard, Nashville; George E. Brewer, New York; William C. Gorgas, New York; William J. Mayo, Rochester; Franklin H. Martin, Chicago.

Term Expiring 1921: Alexander Primrose, Toronto; Albert J. Ochsner, Chicago; George W. Crile, Cleveland; Harvey Cushing, Boston; George E. de Schweinitz, Philadelphia.

Term Expiring 1922: John M. T. Finney, Baltimore; James B. Eagleson, Seattle; Charles H. Mayo, Rochester; J. Bentley Squier, New York; Walter W. Chipman, Montreal.

HOSPITAL STANDARDIZATION

A Review of Progress Presented at the Clinical Congress of American College of Surgeons

GROUP consciousness is a phrase in frequent use today by the medical profession. It means team-work in the practice of medicine, team-work in the responsibility for the care of patients, and team-work in the operation of hospitals. Team-work in the operation of hospitals is especially a subject of new interest among doctors, and that subject was the single theme for papers and discussion all day October 24, during the meeting of the Clincial Congress of American College of Surgeons. The meeting occurred at the Waldorf-Astoria, New York, 3,040 Fellows of the College and other doctors and hospital superintendents being registered. The occasion was a review of what the College has accomplished in hospital standardization during the past year.

The program of the day consisted of a matter-of-fact statement of what the College has done and what it seeks to do in hospital standardization. These subjects were presented by Mr. John G. Bowman, director of the College. The practical application of the work of the College was than presented by a group of doctors and hospital superintendents. Dr. T. M. MacEachern, superintendent of the Vancouver General Hospital, described what hospital standardization meant at that institution. In a similar way Dr. George Gray Ward, Jr., chief surgeon, spoke for the Woman's Hospital, New York; Dr. Edward Thomas Dillon, surgeon-in-chief, for St. Vincent's Hospital, Los Angeles; and Mr. Frank E. Chapman, superintendent, for Mt. Sinai Hospital, Cleveland. Charles B. Moulinier, S.J., president of the Catholic Hospital Association, told of the progress of the Catholic hospitals and of their co-operation in the program of the C llege.

Dr. William J. Mayo, president of the College, presided at the morning session. Dr. Albert J. Ochsner presided at the afternoon session. In an introductory talk Dr. Mayo said in part:

SERVICE FOR THE PATIENT

"I think this hospital standardization has a possibility of good that is not recognized even by those who are engaged in the hospital work itself.

"Now, let us bear in mind all of the time that the doctor and the hospital exist for the benefit of the patient. A good many of us, I believe, have had a wrong idea. Some of us and some of the hospitals have felt that the College endeavors to force upon us some sort of a set standard. I know that there is no such intention on the part of the College. Our aim is merely that with whole-hearted co-operation with the hospitals we may think straight and in some measure give speed to the progress which we all desire.

"Let me say again that the hospital exists for the patient and not for the convenience of doctors. So long as we concede that doctors and the hospitals exist for the patients and that all of our efforts are made for the welfare of patients, we are on ground that is fundamental. We are on ground upon which we can get together and from which we can make progress.

"We must remember that if the patient is to receive what he has a right to receive, the hospital must furnish certain other things besides an opportunity for the doctor to work. Records and laboratories are matters of very great importance. The doctor, and I would say especially the surgeon of the last generation, was not prone to keep very accurate records. He was accustomed to do things in an individualistic way which will not be tolerated in the next generation. We must be tolerant with the doctor of this type and teach him the value of records to himself as well as to the patient. To the hospital, however, it is absolutely essential to have accurate records, for otherwise how can the hospital give an accounting of its service?

"We hear objection sometimes to complete hospital records for private patients. I do not attach much value to these objections. We have had such records in our hospital for over thirty years and there never has been a time when anything has come up that was at all unpleasant about these records. The poor have had records because, let us say, they could not help it; the rich and the middle class are just as deserving as the poor and they haven't the records. It goes without saying, however, that a hospital must safeguard its records in a manner about which there can be no question."

THE MINIMUM STANDARD

To understand hospital standardization, as devised by the College, and its meaning among hospitals, the first essential is to understand the minimum standard of the College. In this connection Mr. Bowman said:

"There is a wide, wide range of conditions in this country and in Canada to which hospitals must adjust themselves. No hospital, as the perfect model to meet all these conditions, has yet appeared. And yet, among all of these conditions, are there not a few details which we can all accept as essential to success in the care of the sick and injured?

"For more than two years the American College of Surgeons, by studying hospital conditions as they are in the field, endeavored to find these essentials. If now we are to make headway in an orderly fashion, it seems advisable that we agree upon some definite starting point or minimum standard. This standard must be practicable and workable. It must be within the reach of the fifty bed hospital and of the thousand bed hospital. It must grow out of the common purposes which we all hold for ourselves, the care of the sick and injured, the education of the medical profession, medical research, and the education of the public in matters of health and hygiene

"After more than two years of work, the minimum standard seemed gradually to find a sort of automatic expression among us. That standard is not the thought of a single mind. It is an expression which grew out of straight thinking among the clearest minds in medical and hospital work on this continent. Its fulfilment costs effort rather than money It safeguards the care of the patient admitted to the hospital by insistence upon competence on the part of the doctor, by thorough study and writing of each case, and by checking up at least once each month of the clinical service of the hospital. It fixes responsibility throughout the hospital. It calls for the 'production sheets' of the hospital. It encourages and even compels clinical research. It defines the minimum of service to the patient, upon which, beyond all debate, we are agreed.

"During the past year staff members of the College have carried personally this minimum standard to about 671 hospitals of 100 beds or more. They have endeavored to explain more vividly than is possible by letter or circular the meaning of this minimum standard. They have endeavored to find out, if the standard is not really what we want it to be, wherein it fails. The reception on the part of the hospital of these visitors has been a constant inspiration to increased effort.

"The minimum standard of the College is familiar to most of you, but let me briefly state it again:

"1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is 'open' or 'closed,' nor need it affect the various existing types of staff organization. The word *staff* is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the 'regular staff,' the 'visiting staff,' and the 'associate staff.'

"2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

"3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, and policies specifically provide:

"a. That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.)

"b. That the staff review and analyze at regular intervals the clinical experience of the staff in the various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analyses.

"4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in an emergency, which includes the personal history; the physical examination, with clinical, pathological, and X-ray findings when indicated; the working diagnosis; the treatment, medical and surgical; the medical progress; the condition on discharge with final diagnosis; and, in case of death, the autopsy findings when available.

"5. That clinical laboratory facilities be available for the study, diagnoses, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluoroscopic service in charge of trained technicians."

"Some figures now may be of interest to you which indicate how far we fall below a simple standard of efficiency. Out of the 671 general hospitals of 100 or more beds in the United States and Canada, 264 hold regular staff meetings with the idea of finding out where their failures are and how they may prevent the recurrence of those same failures. In this group of 671 hospitals, less than half, or to be exact in 301 hospitals, the patients are treated after a physical examination is made and recorded. In the other hospitals of the group, while doubtless the illness of most of the patients is studied, the hospitals themselves have no evidence of such study. As I have asked of you on various occasions before, can a hospital which apparently assumes no responsibility for the care of its patients ask the good will and the confidence and support of its community? Out of the entire group, 198 of the hospitals fulfill the minimum standard as just stated.

"The purpose of the College in its work is to be constructive and not destructive, to encourage and not to discourage. It is our purpose, at the earliest date which all of us working together on this problem may consider right, to publish a list of the hospitals which fulfill the minimum standard. Do you believe it will be wise today to publish a list of the 198 hospitals? One year ago 89 hospitals out of this 671 met this standard. My belief is that one year hence more than 400, possibly 500, of the hospitals will meet this standard. They will then meet this standard, not because any one urged them to do so, but because they, themselves, believe that it is not only right but essential that they should do so. Would it not be the wiser procedure to wait for another twelve months before publishing a list, and in the meantime, in an orderly manner to review the data again with each of the 671 hospitals?

"It seems also that the time has come in which the hospitals of less than 100 beds may now advantageously be 'measured' by this standard. Our program for the coming year, still somewhat tentative, is to include in our survey the hospitals of from 50 to 100 beds as well as the hospitals of 100 beds or more."

On the practical application of the minimum standard to the hospital, Mr. Bowman said further:

"If the trustees of the hospital are responsible that every patient, free or pay, in the hospital receives the best care known to the staff, then they must at frequent intervals be in possession of the facts as to the care received by the patients in the hospital. The trustees must know, for example, if unnecessary surgical operations are performed in the hospital; or if incompetent surgical operations are performed; or if lax, lazy, or incomplete diagnoses are made. If infections occur, they must know, as nearly as may be, the cause of the infection, and make every reasonable effort to remove the cause. If the time of the patient is wasted between his admission to the hospital and the proper study, diagnosis, and treatment of his illness, again the trustees must know the facts and take action promptly to prevent further waste of this kind. Too frequently hospital trustees consider that their duties end with the management of the financial affairs of the hospital.

"How are the trustees to know about their hospitals? Certainly the answer rests with you, the medical profession. It rests chiefly in regular scientific analyses by yourselves of your clinical service. In order to make more clear what such analyses may be, let me cite the clinical record of two series of 100 operations for chronic appendicitis.

	In Hospital No. 1	In Hospital No. 2
Complete physical examination, including blood count	100	14
Number of consultations held	41	2
Working diagnoses recorded in advance of operation	100	None
Progress notes recorded by doctor	100	None
Infections following operation	3	12
Incorrect diagnoses	4	14
Number of patients relieved	94	77
Number patients died	2	9

"The analysis of the cases treated in Hospital No. 1 shows that a complete physical examination was made and recorded for each patient; that in order to clear away doubt as to the diagnoses, consultations were held in 41 cases; that the working diagnoses in these cases were, then, in fairness to the patients, recorded in the permanent records of the hospital; that, after the operations, the physicians or surgeons in charge of each case made or signed daily a statement of the progress of the patient; that infections developed in 3 cases; that the number of incorrect diagnoses was 4; that the number of patients apparently relieved of their illness was 94; and that 2 of the patients died following operation. This record is a credit to the staff of the hospital.

"The corresponding data are now given for a similar series of cases in Hospital No. 2. The data as here presented could not occur in a hospital which meets the Minimum Standard. In a hospital which meets the Minimum Standard, for example, it is not possible that any patient,

except in an emergency, will go to operation in advance of a complete physical examination. But in Hospital No. 2, 86 of the patients were operated upon without a complete physical examination. They were operated upon, it seems, after guess-diagnoses rather than after scientific diagnoses with consultations when indicated.

"Considering the record of Hospital No. 2, is there anything unreasonable in asking that the staff meet at least once each month; that it analyze the facts of its clinical work; that it determine, as nearly as may be, the causes of its failures; and that, demanding the support of the trustees, it endeavor to remove these causes? For example, 12 of the cases developed infection. Whose cases were these? What is the nature of the infection as indicated by laboratory analysis? Were the cases operated upon in rooms where pus cases had also recently been operated upon? Is the sterilization in connection with the operating room effective? When was it 'ast tested and how? What technique is carried out in connection with surgical operations? If the staff of Hospital No. 2 would in dead earnest ask such questions as these each month, the percentage of infections would undoubtedly decrease. If the staff-review were really penetrating, the percentage of deaths would undoubtedly decrease. Matters, too, of incompetence, when the facts indicated incompetence, would be dealt with in no uncertain manner. The staff would become restricted. The doctor scarcely exists who, if incompetent and if his incompetence is brought to light at frequent intervals, will not endeavor promptly either to perfect his training or retire from membership on the staff. The same principle is true with regard to character and professional ethics. Can any staff rest content with less than its maximum effort at all times to perfect the service of its hospital?"

CO-OPERATION OF CATHOLIC HOSPITALS

Charles B. Moulinier, S.J., said:

"We cannot dwell on fundamentals too often or too much in order to bring about best results. We must think in terms of staff organization, case records, and adequate laboratory service. These things mean hospital standardization. Everybody who knows anything about modern medicine knows that it has passed out from the individualistic practice of the past into the group practice of the present. . . .

"The standardization of hospitals is nothing more than the bringing about of a similar situation among the hospitals. Team-work and co-operation on the part of each worker in the hospital is essential; and if we are to have team-work and co-operation, we must have organization. Organization is the cornerstone of the whole edifice. If there isn't organization among the doctors—real, genuine, active organization, including their minds and their hearts and their wills—if it isn't so strong as to dominate selfishness and put it in the background, as to make them forget personal interests and personal ambition in view of the needs of the patient, then the organization means nothing.

"But organization must not end with the staff; it must include the managing personnel, whatever that be—board of trustees, superintendents, Sisters. They must be organized. They must know what they are for, what they are doing, what the whole purpose of the hospital is; and they must from day to day be imbued with the spirit that it is only by team-work in their hospital that the patient can get what he has a God-given right to.

"Organization of that kind is bound to result in records—full records, complete records, genuine, true, scientific records, that are the pledge to the patient of what the hospital has done for him or her; that are the guarantee to the public of what is being done in the hospital; that are the testimony to the medical profession that the doctors, managers, and nurses are doing their professional duty to the sick. You know better than I do that al' growth in medical knowledge comes out of the records; that it does not spring directly out of the mere thinking of medical men, the mere working in the laboratory, the mere cure of patients. It springs from orderly, accurate records. You know that the textbooks are made up from records of the past; that the medicine of the moment is in the records that are being formed, and that this knowledge later finds its way into the literature, into the journals and the books with which your shelves are so filled.

"Records are absolutely necessary. Any hospital that does not keep records or any medical man who does not keep records is derelict in duty to the patient, to the public, and to the profession."

Father Moulinier emphasized also the importance of clinical laboratory service. Then in closing he said:

"I am just going to say in closing that I pledge to the American College of Surgeons, with all the official capacity I have, that the Catholic Hospital Association, with whatever force and power it has, that the hierarchy of the Catholic Church, that the clergy of the Catho'ic Church, and that the great body of twenty or thirty thousand

Sisters working in Catholic hospitals, are going to co-operate with the College to the highest point. Just be patient a little here or there and you will be satisfied, not to say delighted, with the kind of co-operation you will get from the Sisterhoods and from all this Catholic body."

ACTION OF CANADIAN HOSPITALS

In speaking of hospital standardization at the Vancouver General Hospital, Dr. T. M. MacEachern, the superintendent, illustrated his subject with lantern slides. The slides illustrated both the forms of keeping records in the hospital and of analyzing these records by the staff. A point of considerable interest was the employment by the hospital of a director of medical records who, with an organization under him, is responsible for the carrying out of the rules and regulations, which the staff has recommended and which the board of trustees has approved, governing the care of patients in the hospital. The director of medical records follows in a kindly and yet critical way the progress of each patient in the hospital. Each month he prepares an analysis of the work done in all departments of the hospital, and this analysis is presented to the staff for its consideration. Dr. MacEachern reported enthusiastically for the success of the plan.

At the beginning of his talk Dr. MacEachern said:

"I bring to you today, I trust, an encouraging report from the Vancouver General Hospital, and I bring also gratitude and encouragement from the Province of British Columbia and from Western Canada. On my way through Alberta and Saskatchewan I found that the hospitals were actively molding their policies along the lines of hospital standardization which we have just heard here outlined. That plan has come to us at the psychological moment. It has come at a time when reconstruction among our hospitals is uppermost in our minds, and at a time when all of our people are enthusiastic to create for themselves the right sort of institutions through which they maintain their right to be well. The College has helped us enormously as hospital workers. We are not only all pledged to hospital standardization, but we are also now engaged in carrying out the program of hospital standardization in a real and practical fashion."

AT THE WOMAN'S HOSPITAL, NEW YORK

Marked interest centered in the work at The Woman's Hospital, New York, as directed by Dr. George Gray Ward, Jr., with regard to staff meetings. Dr. Ward said:

"A staff conference is held once a week throughout nine months of the year which the entire hospital staff is always expected to attend. These conferences last about one hour and the medical public is welcome. The order of procedure is as follows:

"*Presentation by the pathologists* of the pathological material of interest which has been obtained during the week; gross and microscopical specimens together with brief talks on the pathology.

"*The casualties of the service* are next called for. Each attending surgeon must report any deaths, infections, or complications occuring during the week in patients under his care, and an endeavor is made to locate the cause. The details as shown by the case histories, and the testimony of those concerned are carefully analyzed in order that it may be determined, as far as possible, whether the fault lay with the doctor, the patient, the disease, or the hospital organization or equipment.

"*A report on the analysis* of the 'follow-up' clinic of one of the attending surgeons is next made. Each of the four attending surgeons have such a clinic once a week which they must attend in person, and once in four weeks they are required to make an analysis of the results of the cases they have seen since their previous report. This analysis must show the total number of cases seen in the clinic and the number of those which have previously been reported. The remainder which are to be reported are classified according to the results as successful, partially successful, and failures. The acid test for the determination of the result is whether the patient has been relieved of the symptoms for which she sought relief, and not whether the operative result is satisfactory to the surgeon. The successful cases are disregarded, while each partially successful case and failure must be analyzed in detail and the reasons given for the classification. A free discussion is encouraged in order that the operating surgeon may have every opportunity to defend his position. Cases that may have been previously reported as successful and which may later become partially successful, or failures, must be subsequently reported with their revised classification.

"*A report of a few cases* of special interest is next made by some of the attending surgeons, in turn. Thus an opportunity is given to report on case histories or to present patients who have been treated with successful results. Frequently a case presenting difficulties in diagnosis or treatment is shown, and the advice of the conference is sought. Once each month the junior attending surgeons are

required, in turn, to give a brief summary of the recent gynecological and obstetrical literature, or to give a report on any hospital or operative clinic they may visit. Problems relating to technique, operating rooms, sterilizing rooms, wards, etc., are brought forward for general discussion when necessary, in order that the various points of view may be obtained. A stenographer is present during the conferences who makes complete stenographic reports of the proceedings, which are kept on file in the office of the chief surgeon for further study."

AT ST. VINCENT'S HOSPITAL, LOS ANGELES

Dr. Edward T. Dillon, surgeon-in-chief at St. Vincent's Hospital, Los Angeles, thus described what standardization means to his hospital:

"For many years St. Vincent's Hospital was conducted as a general open-staff hospital. It assumed no direction in methods of examination or treatment employed. It executed orders only of general care and nursing.

"However, the idea of bettering this situation grew and developed. Then, to accomplish a reform, it became necessary to subordinate the individual, to overturn a routine of years, to co-ordinate the efforts of the hospital and of the physician, to eliminate those of the profession who failed to meet the demands and responsibilities of a more complex organization, to do the best for humanity regardless of the personal equation.

"Briefly, we required these things: Signed records, including the personal history, physical examination, routine blood and urine examinations, and recorded blood pressure in all cases before any treatment whatsoever is instituted. There are no exceptions to this rule. Clinical diagnosis must be supported by laboratory findings. Patients may not be taken to the operating room unless accompanied by these records together with a written pre-operative diagnosis. All tissue removed remains in the possession of the hospital, and, as a routine, is sent to the laboratory for analysis and report. All records, together with the summary, final result, and follow-up card remain in and are the property of the hospital. Records are inspected, and there must be the proper co-ordination between recorded findings, diagnosis, and proposed treatment. This applies particularly to surgical cases. Post-operative complications, delayed or unsatisfactory results, are not considered a matter of individual responsibility They are investigated by the authoritative co-operation of the staff and the hospital administration, and the cause determined if possible. Regular meetings of the staff afford opportunity for discussion of problems of procedures connected with the hospital.

"The hospital does not now hesitate to refuse admission to such patients as have incompetent medical or surgical advisors. The question of their refusal or admission is no longer a personal or individual matter, but merely the meeting of certain well-founded regulations.

"These things have not been accomplished without friction and criticism. But we have zealously endeavored to establish the merit of what we stand for. Already, discontent with and antagonism to the new order have practically disappeared. The benefits derived from the adopted measures of standardization have come to all patrons of St. Vincent's Hospital both within and without the profession. The careless or indifferent practitioner has benefited by examples of conscientious work and its fruitfulness; the incompetent practitioner has been excluded from the privileges of practice in the hospital. Patients have shown their appreciation of this great work through an increased waiting list for entrance to the hospital. The community at large has realized in a short space of time that the standardized hospital offers a superior service. Its appreciation has also been shown by the demand for a larger institution and by offers of financial assistance to carry the work still further."

AT MT. SINAI, CLEVELAND

Mr. Frank E. Chapman described in detail the application of standardization principles at the Mt. Sinai Hospital, Cleveland, where he is the superintendent. In drawing a parallel between a well-run manufacturing organization and the routine of a well-run hospital, he said:

"In the manufacturing plant, we see first the administrative head, represented by either an individual or by a governing board entrusted with matters of finance, matters of external policy, etc. Next we see a group of department heads, representing what is commonly termed the 'shop council.' One of the functions of the administrative head is to create an 'esprit de corps' in this council that will tend to produce a maximum of efficiency throughout the shop. This shop council, as a rule, is responsible for the operation of the plant, for the formulation of internal policies, and is held directly responsible for the output. It is incumbent upon this body to develop such efficiency methods as are necessary to produce a maximum result. It is a general practice that this council formulate for itself a

system of records that will show from time to time the performance of the various units of the shop. These records are compiled in the accounting department, and show at a glance the relative performance of the shop as a whole, the production, the cost of production, and such other information as is necessary for a study of performance In addition thereto, and considered as a legitimate part of the cost of manufacture, is maintained a laboratory for testing the product of the plant, also for developing new procedures and new methods of manufacture. These compiled statistics, both from the shop and from the laboratory, are used as a basis for passing judgment upon the efficiency of the shop as a whole.

"Let us now see how close a comparison can be drawn with a hospital organization.

"First, we have the administrative head, functioning identically as does the administrative head of the manufacturing plant. Next, we have the shop council, or in other words, the medical staff. No institution, no matter what its physical development, can be of much value without an 'esprit de corps' in its staff that can surmount the obstacles that are bound to develop. The administrative head must do everything possible to create this spirit by furnishing to the organization the facilities necessary for an efficient performance of its duties. It is equally essential that this group be cognizant of the aims of the administration, and that in turn the administration know the aims of the staff, that there may be a co-ordinated effort toward the attainment of a goal.

"You should not expect a busy member of the attending staff to be responsible for the actual taking of records, just as you should not expect the operator of a given piece of machinery in a plant to be responsible for the recording of the performance of that unit. If you are to get proper case records, or if you are to get proper production records, it is essential that the administration furnish, through the council, the machinery to make this record. At Mt. Sinai, we meet the need of the staff by providing dictating machines.

"A production record in itself is of little value unless it is compiled for comparative purposes. Equally true is the statement that case records are of little value if they are written only to be filed. It is here that the statistician, or cost clerk, becomes of use. But please do not understand that this statistician is in any way a judge of the performance of the plant or of the hospital. It is merely his or her duty to compile the results as demonstrated by the production records, these results to be passed upon by the shop council. I feel that this is a very important point to make, that the staff itself must be the judge of its own performance, keeping in mind at all times, however, that it is definitely a part of the duty of the administrator to know that the results developed are carefully studied by the staff, and that a conscientious endeavor is made to improve conditions.

"It is almost inconceivable that a manufacturing plant would operate without these cost and production records. Is it therefore not equally essential that a hospital, that deals in a commodity much more precious than one of dollars and cents, be as zealous in its performance and apply every known means to the development of an efficient end-result?"